



**INSTRUCTION 67-9319
INJECTOR CALIBRATOR CD3**

Part Number 67-7622 to 67-7627

**Installation/Operation/Maintenance
Rev. 8 – January, 1999**

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APPENDIX A Calibrator Audit Kit

TECHNICAL DATA AND FEATURES

- Synchronous drive motor
- Digital fuel measurement
- Floor standing unit; full welded frame construction
- Operating speeds: 1050 RPM (Cummins), 2000 RPM (DD)
- Cast iron cambox with tapered roller bearings and quick change cam capability
- Injector clamping: hydraulic
- Calibration fluid reservoir capacity: 8 U.S. Gallons (30 liters)
- Filtration:
 - Primary filter (spin-on type): 10 micron
 - Final stage filter: 3 micron
 - Flowmeter transducer: screen
- Calibration fluid temperature control:
 - Solid state control
 - $104^{\circ}\text{F} \pm 1^{\circ}\text{F}$ (factory setting)
 - Cooling by cold tap water
 - Heating by two 500 watt immersed electric heaters
- Instrumentation & Controls:
 - Injector Supply (Rail) Pressure Gauge, 4" Dial, Scale: 0-200 psi.
 - Calibration Fluid Temperature Gauge, 4" Dial, Dual Scale: 40-140°F (5-60°C).
 - Supply pressure regulator
 - Clamping pressure regulator
 - Main drive start, stop switches
 - Measurement system start switch
- Measurement System:
 - Positive displacement Flowmeter (U.S. Patent No. 4141243)
 - Measurement Units - $\text{mm}^3/\text{str.}$
 - Digital display resolution - $0.1 \text{ mm}^3/\text{str.}$
 - Measurement sampling - 50 or 100 strokes
 - Stroke counter - electronic/optical
 - Accuracy: $\pm .75\%$ of reading or $1 \text{ mm}^3/\text{str.}$ whichever is greater

TECHNICAL DATA AND FEATURES (Continued)

- Indicator Lights:
 - Power (red) - Heat/Cool (amber) - Clamping (amber).
- Accessibility: Two front and one upper left hand side hinged doors. All other panels have quick turn fasteners for easy removal.
- Dimensions: 50"W (1.27m) x 30"D (.76m) x 56" H (1.42m)
- Weight (Dry): 1150 lbs. (521 kg)
- Utilities Required:
 - Electrical:

ELECTRICAL OPTIONS					
Part #	Voltage	Phase	Freq.	3 HP Motor Amps	5 HP Motor Amps
67-7622	230 VAC	3	60 Hz	24	33
67-7623	460 VAC	3	60 Hz	12	17
67-7624	208 VAC	3	60 Hz	26	38
67-7625	220 VAC	3	50 Hz	25	35
67-7626	380 VAC	3	50 Hz	15	20
67-7627	440 VAC	3	50 Hz	13	18

- Air Pressure: 80-120 psi (2 CFM).
 - Water: Cold tap, approximately 1.2 GPM (4.5 liter/min).
- Accessories:
 - Accessories are available for mounting and testing of all Cummins injectors (mechanical) and injectors (mechanical) manufactured by Diesel Technology Corporation for engine models 53, 71, 92, 92 marine, 149, and 8.2L. These accessories must be ordered separately.
 - Provision for hanging all accessories on pegboard inside lower doors.

1.0 INTRODUCTION

Bacharach Model CD3 Injector Calibrator provides fast, accurate and safe calibration of mechanical unit injectors manufactured by Cummins Engine Company and Diesel Technology. The calibrator will accommodate the Cummins H-NH, J, and C flanged injectors, plus all cylindrical types, as well as injectors manufactured for Detroit Diesel (DD) engine model numbers 53, 71, 92, 92 Marine, 149, and 8.2L.

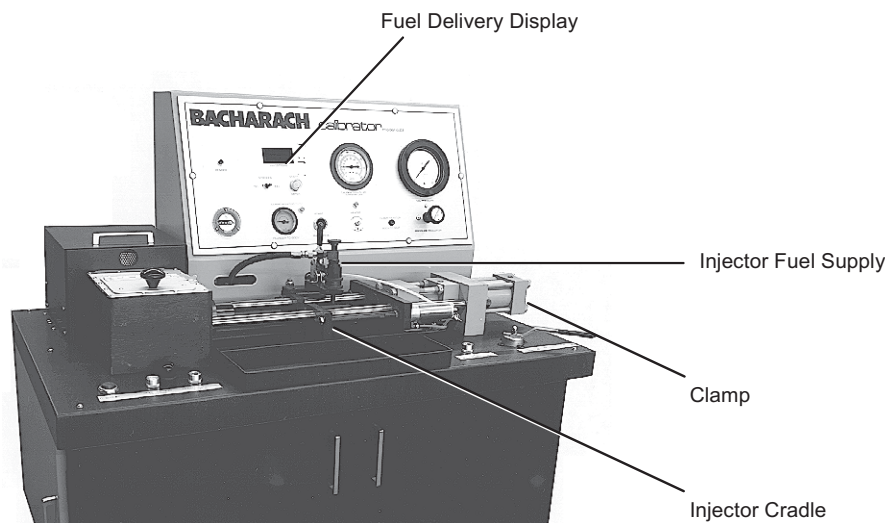


Figure 1-1. CD3 Injector Calibrator

The CD3 was tested at the Bacharach factory with high precision instruments and calibrated for:

- Injector supply pressure
- Calibration fluid temperature
- Flowmeter and calibrator accuracy
- Correct clamping forces (body-to-seat and plunger-to-body)
- Discharge head (Cummins) performance
- Accuracy with Detroit Diesel (DD) master injectors

These can be checked and recalibrated, if necessary, by a qualified service technician using precision equipment available from Bacharach in an Audit Kit (part number 67-7707). See Appendix A.

1.1 Calibrator Features

INSTRUMENT CONSOLE FEATURES (Refer to Fig. 1-2)

Feature	Operation
RAIL PRESSURE Gauge	0 to 200 psi, accurate to $\pm 1/4\%$, has a 4-1/2 in. dial, and a mirror scale to avoid parallax. Calibrated at the factory and offset to indicate true pressure at injector inlet.
CALIBRATION FLUID TEMPERATURE Gauge	40° to 140°F (5° to 60°C) has a 3-1/2 in. dial, accurate to $\pm 1^\circ\text{F}$ (calibrated at the factory to indicate the true temperature at the injector inlet).

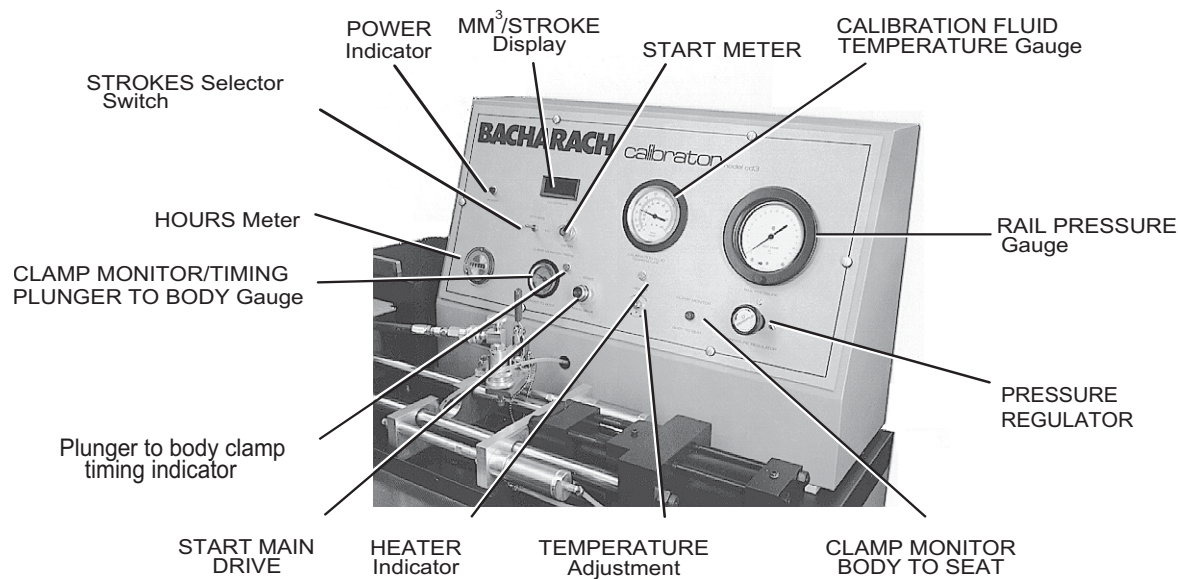


Figure 1-2. Console Features

Feature	Operation
START METER Button (Flowmeter)	Switches on flowmeter. Lights while meter is running.
MM ³ / STROKE Display (Flowmeter)	Four-digit LED display with resolution of 0.1 mm ³ /stroke (Red flashing dot indicates update in LED display).
STROKES Selector Switch (Flowmeter)	Selects 50 or 100 strokes per reading.
POWER “ON” Indicator (light)	When lit, indicates that the On/Off Switch is closed, and the pump for circulating calibration fluid and providing clamping pressure is operating.
HOURS Meter	0 to 9999 hours (counts total hours while On/Off Switch is on).
CLAMP MONITOR/TIMING, PLUNGER TO BODY gauge	Factory set to indicate proper plunger-to-body clamp force. When pointer points to the green segment of the dial, clamping force is 380 lb ±10 lb.
Plunger to Body Clamp Timing Indicator (light)	Lights for about 3 seconds during clamping operation.
START MAIN DRIVE Button	Applies power to main drive motor. Starts camshaft rotation and the injector supply pump.
HEATER “ON” Indicator	When lit, indicates power is being applied to calibration fluid reservoir heater.
TEMPERATURE Adjustment (Potentiometer)	Permits manual setting of calibration fluid temperature.

Feature	Operation
CLAMP MONITOR BODY-TO-SEAT (Cummins)	Monitors the injector body-to-seat clamping force. When clamping force is low, the indicator shows black. When clamping force is correct, the indicator shows green.
PRESSURE REGULATOR RAIL PRESSURE gauge	Precision diaphragm-type pressure regulator allows the pressure of the calibration fluid supply to the injector to be set as indicated on the (Injector Supply).

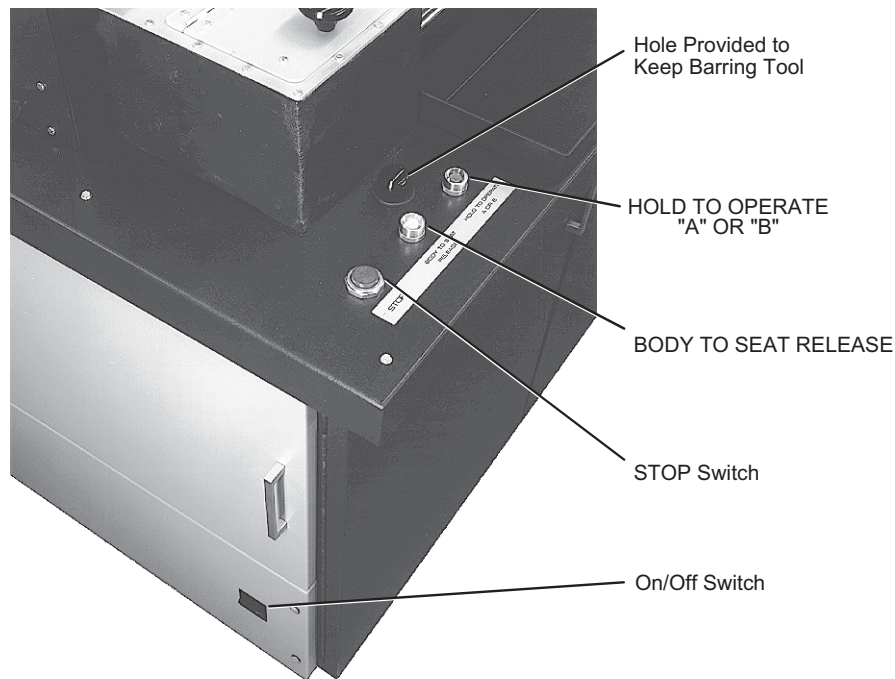


Figure 1-3. Left Table Features

LEFT OPERATOR'S TABLE FEATURES

Feature	Operation
On/Off Switch	For switching the control circuit power on and off. When switched on, starts the clamp pump motor which then runs constantly. Also turns on the calibration fluid automatic temperature control and hour meter.
STOP Button	Shuts down main drive motor.
BODY TO SEAT RELEASE Button	Applies air pressure to the two clamping cylinders that drive the body to seat clamp cylinders to the full, extended (release) position.
HOLD TO OPERATE	Unlocks the main clamp cylinder. Functions only when main drive motor is OFF.

Feature	Operation
"A" OR "B" Button	There is no physical movement of the clamping mechanism when this button is pressed but it must be held down to operate the body to seat clamp or plunger to body clamp. This is part of the two hand safety operation system.

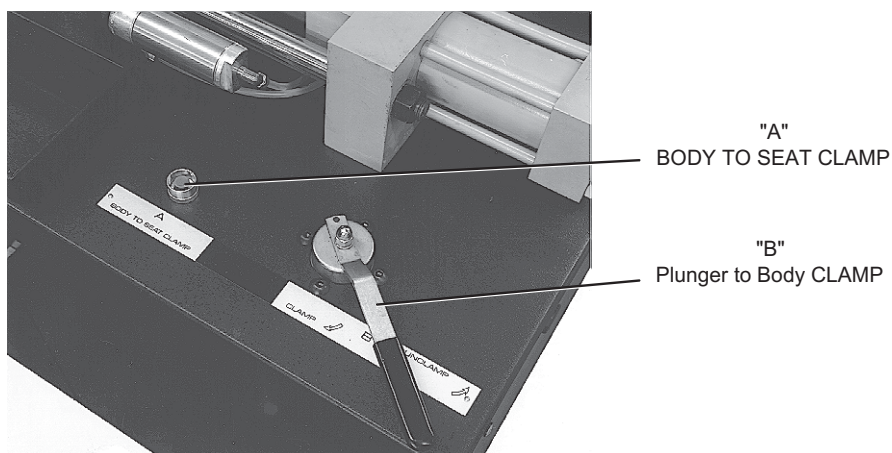


Figure 1-4. Right Table Features

RIGHT OPERATOR'S TABLE FEATURES

Feature	Operation
"A" BODY TO SEAT CLAMP Button	Clamps body to seat. Will operate only when flywheel is in a certain angular position and the HOLD TO OPERATE "A" or "B" button is held down.
"B" Clamp/Unclamp lever (4-way selector valve)	Clamps plunger to injector body. Will operate only when the HOLD TO OPERATE "A" or "B" button is held down.

1.2 Accessories

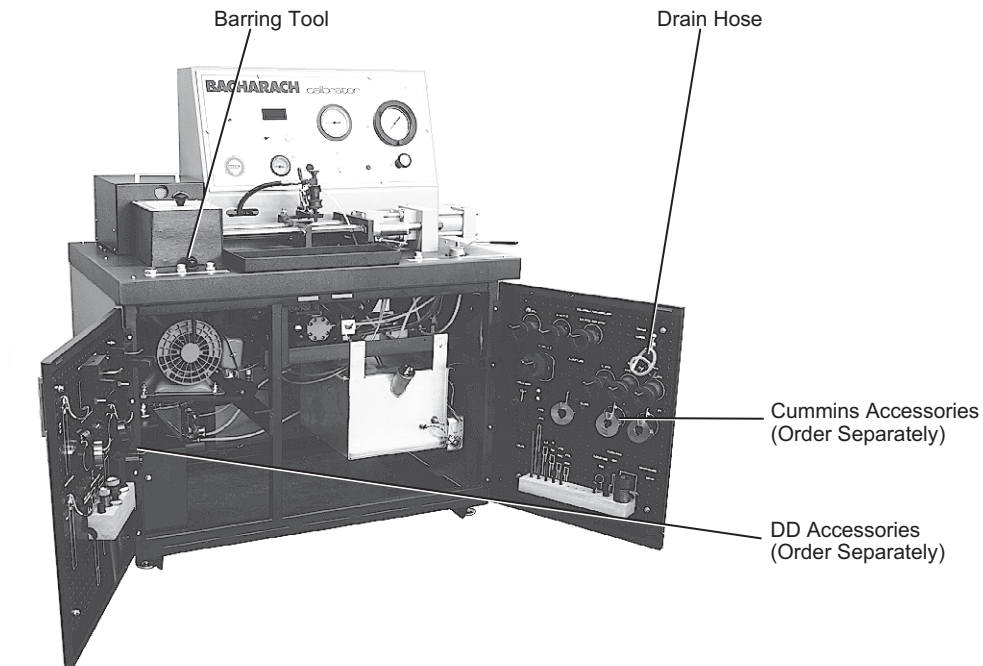


Figure 1-5. Accessories

The accessories for the CD3 come in three different sets.

1. The Basic Accessories (not shown) supplied with.
2. Accessories for the Cummins Injectors.
3. Accessories for the DD Injectors.

A lists of all parts in the accessories kits are given in Chapter 5. Accessories for testing Cummins or DD injectors are supplied if ordered separately. They come with hooks for hanging them inside the front doors.

1.3 Construction

Cabinet: The frame is of welded steel 1-1/4 inch square tubing and angle iron. The upper left side and both front doors are easily accessible for changing speed, storing accessories, and performing routine maintenance through hinged doors. All other external panels are secured with 1/4-turn fasteners for easy removal. Rotating parts are protected with a hinged cover, safety interlocked with the main drive motor.

Console and operator's table: The instrument console is mounted to the operator's table with vibration absorbing mounts for the controls and gauges. Vibration absorbing leveling pads are provided for easy leveling of the unit.

Calibration Fluid Reservoir: The calibration fluid is stored in a 8 U.S. gallon (30 liter), thermostatically controlled reservoir which is used in common by the injector test fuel supply and the clamping circuits. Contained in the reservoir are two 500-watt electric heaters and a cooling coil. The reservoir also has a dipstick and two drain valves.

Injector clamping: Injectors are clamped using a hydraulic cylinder. The cylinder is locked mechanically at all times. An air driven hydraulic pump called an intensifier provides the high pressure required to unlock the clamp cylinder.

Pneumatic clamping: Two double-acting air cylinders are used in clamping the Cummins injectors body to seat.

Circulating and clamp cylinder pump: A 1/3 HP electric motor drives the gear pump supplying fluid to the double-acting hydraulic cylinder which clamps and unclamps the injector. The motor and pump run continuously which keeps the calibration fluid circulating to stabilize fluid temperature.

Main drive motor: The calibrator is powered by an 1800 RPM synchronous speed electric motor operated by a starter with overload protection. This motor drives the camshaft which in turn activates the plunger in the injector being tested. The motor also drives the injector supply pump.

Pulleys: A pulley arrangement between the main motor drive shaft and the cam shaft offers two speed settings. The motor is mounted on a hinged plate and a barring tool inserted into the yoke permits quick speed change over from CUM (1050 RPM) to DD (2000 RPM) or vice versa.

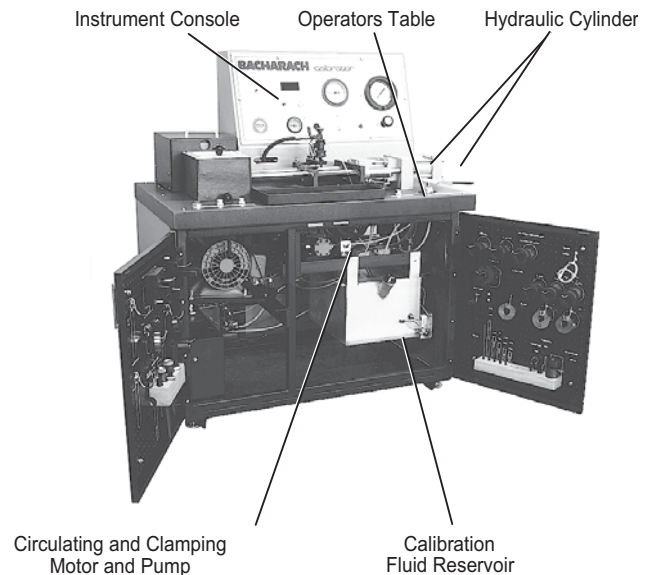


Figure 1-6. Cabinet, Console, Operators Table, Reservoir & Clamping

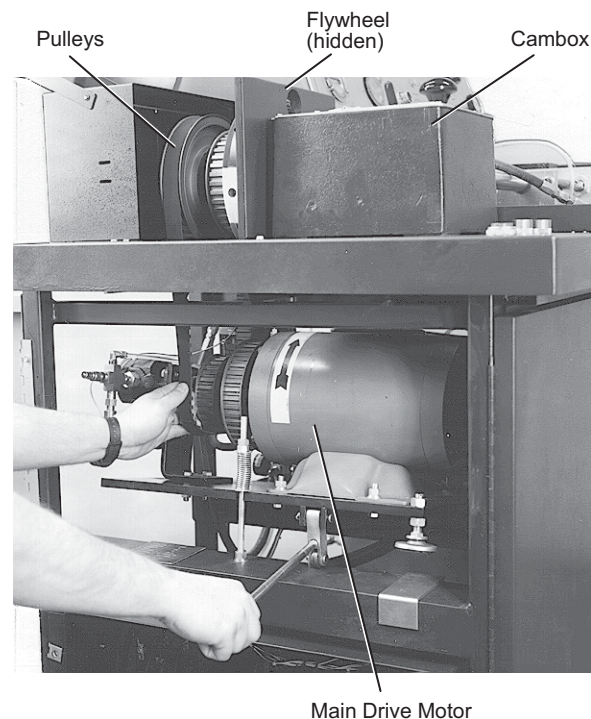


Figure 1-7. Main Motor, Pulleys, Flywheel, & Cambox

Flywheel: A flywheel is mounted on the driven end of the camshaft for uniform rotation. An encoder wheel, also mounted on the camshaft in conjunction with an optical pickup, counts strokes.

Cambox: The cambox is constructed of cast iron and contains a 1-1/2 inch diameter camshaft supported by heavy duty tapered roller bearings. The cam is mounted to one end of the shaft on a non-locking taper, secured by a nut and washer. The driving torque is transmitted by a key and keyway which allows quick and easy cam changes. The rotating cam dips and splashes to lubricate the cam, bearings, tappet, roller, and pusher rod.

Flowmeter transducer: For measuring fuel output of the injector, the calibrator uses a positive displacement flow measuring device with a digital readout.

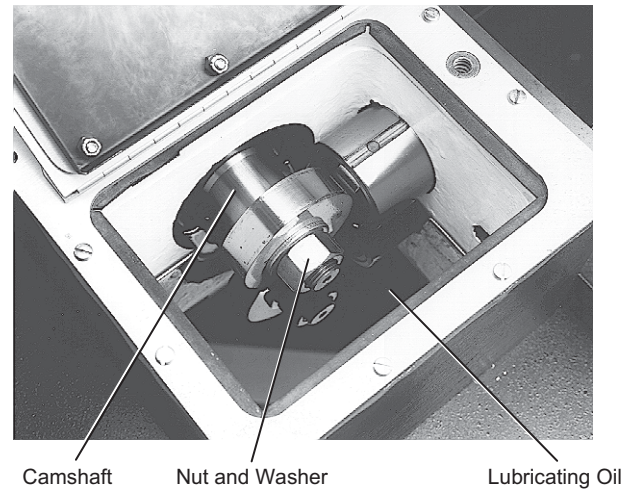


Figure 1-8. Cambox Parts

1.4 Calibration Fluid System (Figure 1-10)

The calibration fluid system consists of three separate circuits:

- a. The clamp and unclamp circuit, which also provides continuous circulation of calibration fluid for close temperature control.
- b. The injector supply circuit (rail pressure).
- c. The flowmeter circuit (injector output).

(a) Clamping Circuit (Plunger to Body) (Figure 1-11)

For plunger-to-body clamping of Cummins and clamping of DD injectors, a double-acting hydraulic cylinder (8) is used.

The hydraulic cylinder is mechanically locked under normal operating conditions by an interference fit between the sleeve and the piston. To allow the cylinder to move for clamping or unclamping an injector, an intensifier assembly applies high hydraulic pressure to the sleeve.

The intensifier assembly (Fig. 1-14A) consists of an air driven hydraulic pump, reservoir, 3-way air solenoid valve, and a 2-way hydraulic air release valve. With power on, under normal operating conditions, the 2-way hydraulic air release valve is open so that pump output is vented back to the reservoir.

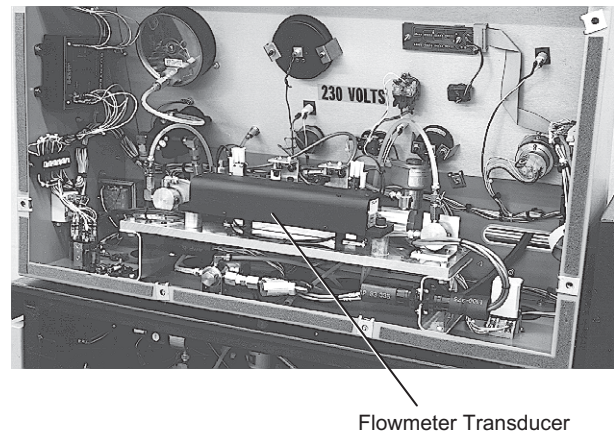


Figure 1-9. Flowmeter Transducer

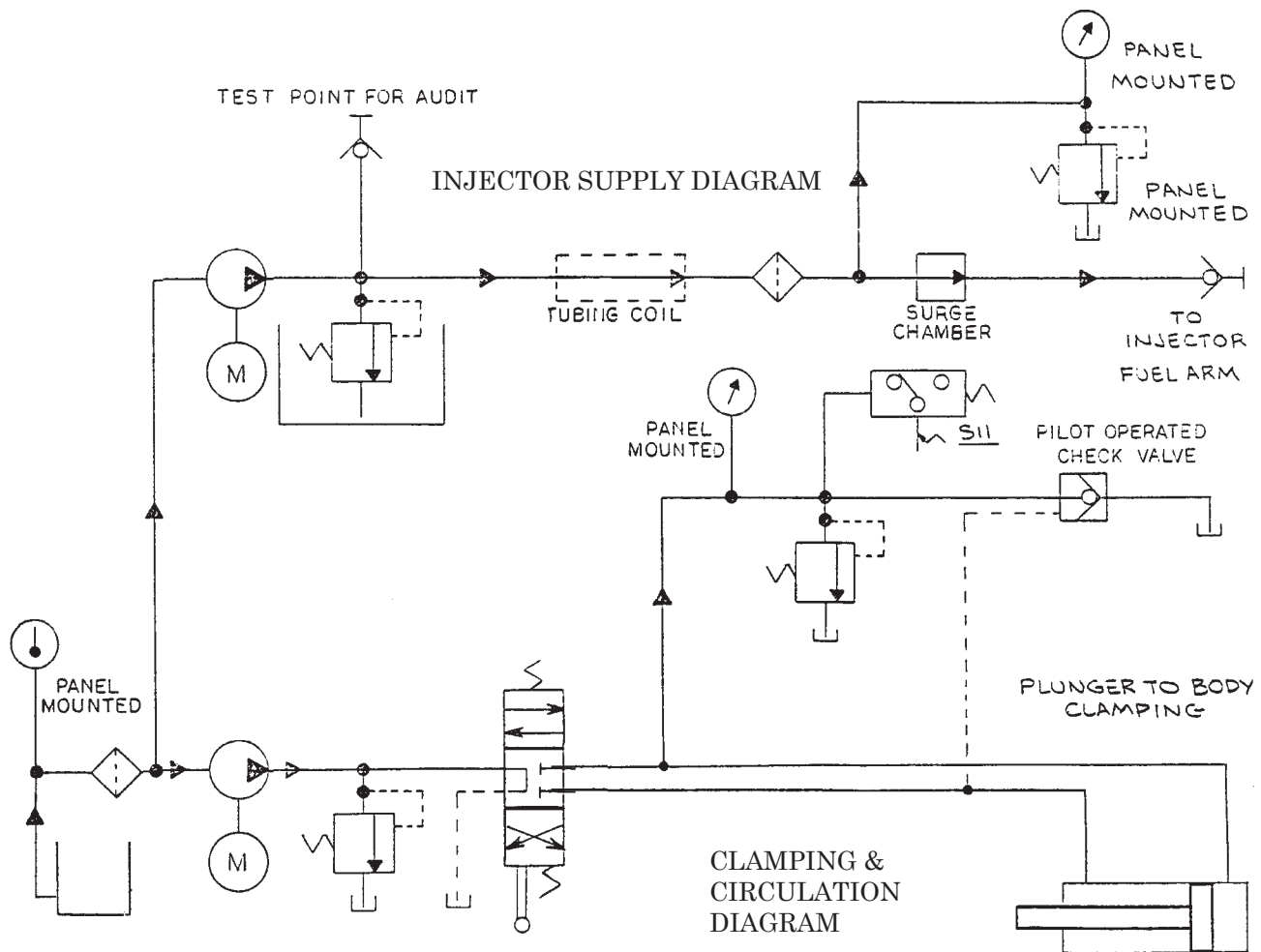


Figure 1-10A. Calibration Fluid System Schematic

When a clamp or unclamp operation is desired (initiated by pressing HOLD TO OPERATE A or B), the 3-way air solenoid valve is energized and the 2-way hydraulic air release valve closes. Air is admitted to air-driven hydraulic pump, generating high pressure to unlock the hydraulic cylinder. As long as the button is held down, this pressure is applied so the cylinder piston is free to move.

To move cylinder piston, a clamp pump (3) driven by a 1/3 horsepower electric motor supplies (from reservoir) (1), and externally mounted filter (2), fluid to the cylinder through a relief valve (4) and across a 4-way selector valve (5).

A lever on operator's table marked CLAMP/UN-CLAMP "B" controls selector valve. A back-pressure regulator (7) is in the line to maintain pressure to produce a clamping force of 380 ± 10 pounds.

NOTE: Do not disturb the setting of this regulator: it was set by the factory and

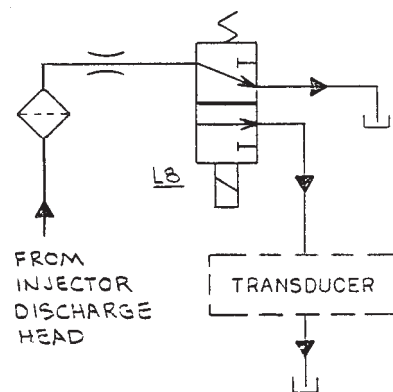


Figure 1-10B. Calibration Fluid System Schematic

should be adjusted only with the use of precision equipment. This equipment is available from Bacharach in Audit Kit (67-7707).

When lever "B" on the operator's table is in the CLAMP position, fluid is directed to the blind side of the cylinder to extend it for injector clamping.

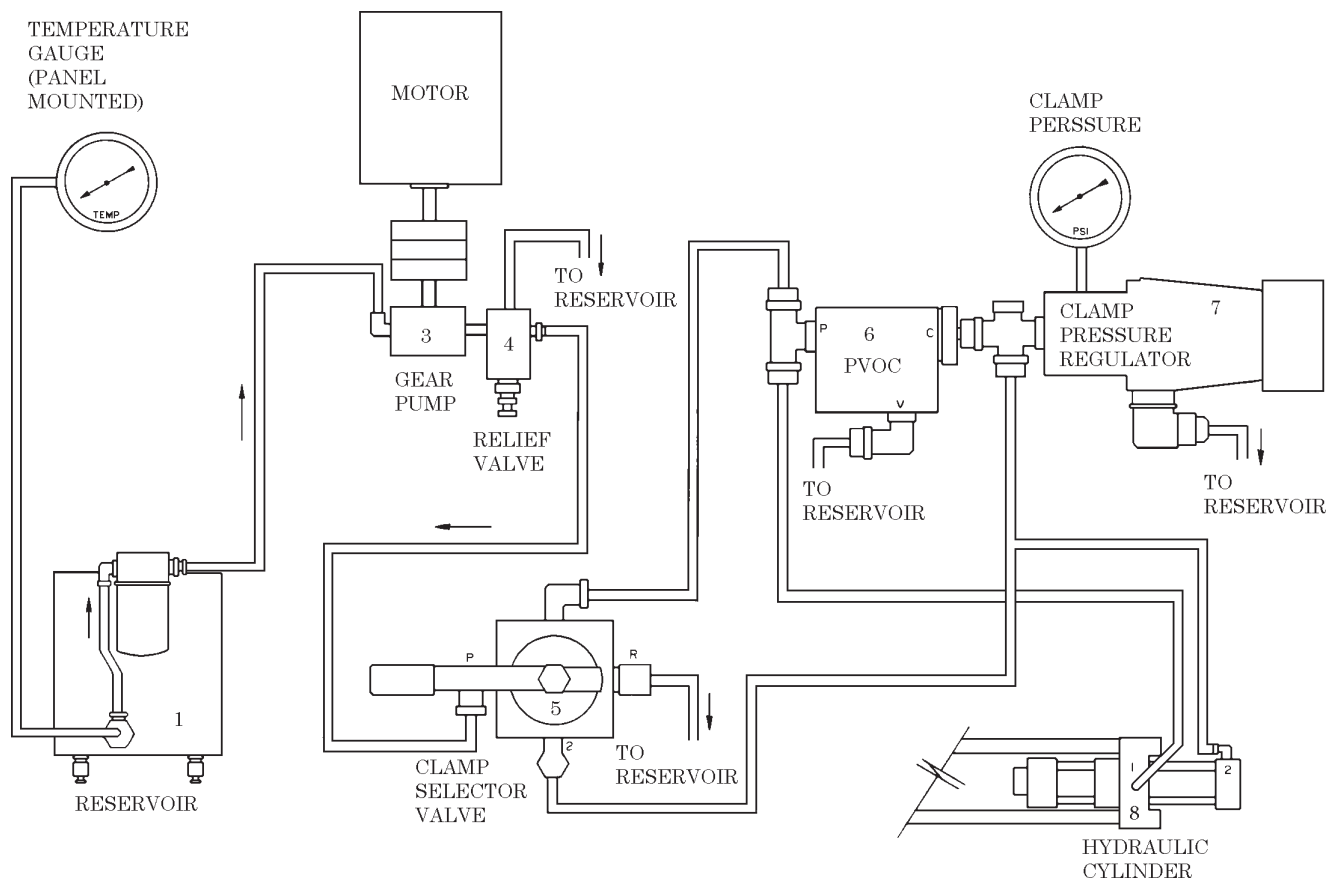


Figure 1-11. Clamping Circuit

When lever “B” on the operator’s table is in the UNCLAMP position, fluid is directed into the rod side of the cylinder to retract it for unclamping. During cylinder retraction and when the piston reaches the end of its travel, the relief valve (4) dumps the fluid to the reservoir.

The same pressure is also used for the pilot to open the check valve (6) which helps to accelerate the piston retraction.

During retraction, fluid from the blind side of the cylinder is displaced through the selector valve and the pilot operated check valve to the reservoir.

When lever “B” on operator’s table is in “neutral” (normal) position, all calibration fluid is routed to the reservoir so it can be kept at a stable temperature.

(b) Injector Supply Circuit (Rail Pressure) (Fig. 1-12)

The injector supply and the clamping circuits share the suction filter. All three circuits share a thermostatically controlled reservoir of calibration fluid.

Calibration fluid is drawn from the reservoir (1) through an externally mounted suction filter (2) and is routed to the gear pump (3).

Fluid is then routed to a final stage filter (5) through a steel capillary tube (4), which acts as a damper to reduce the cyclic pressure variations of the gear pump.

From the filter, the fluid is routed to a steel surge chamber (6), which reduces pressure fluctuations due to the injector metering cycle. A precision back pressure regulator (7) controls pressure of the calibration fluid.

A spring-loaded injector fuel arm (8) admits fluid into the inlet orifice of the Cummins cylindrical injector. The arm contains a spring loaded shutoff valve which opens as the fuel arm is lowered onto the injector orifice by an over-center toggle clamp.

For the Cummins flanged and DD injectors the fuel arm is bypassed.

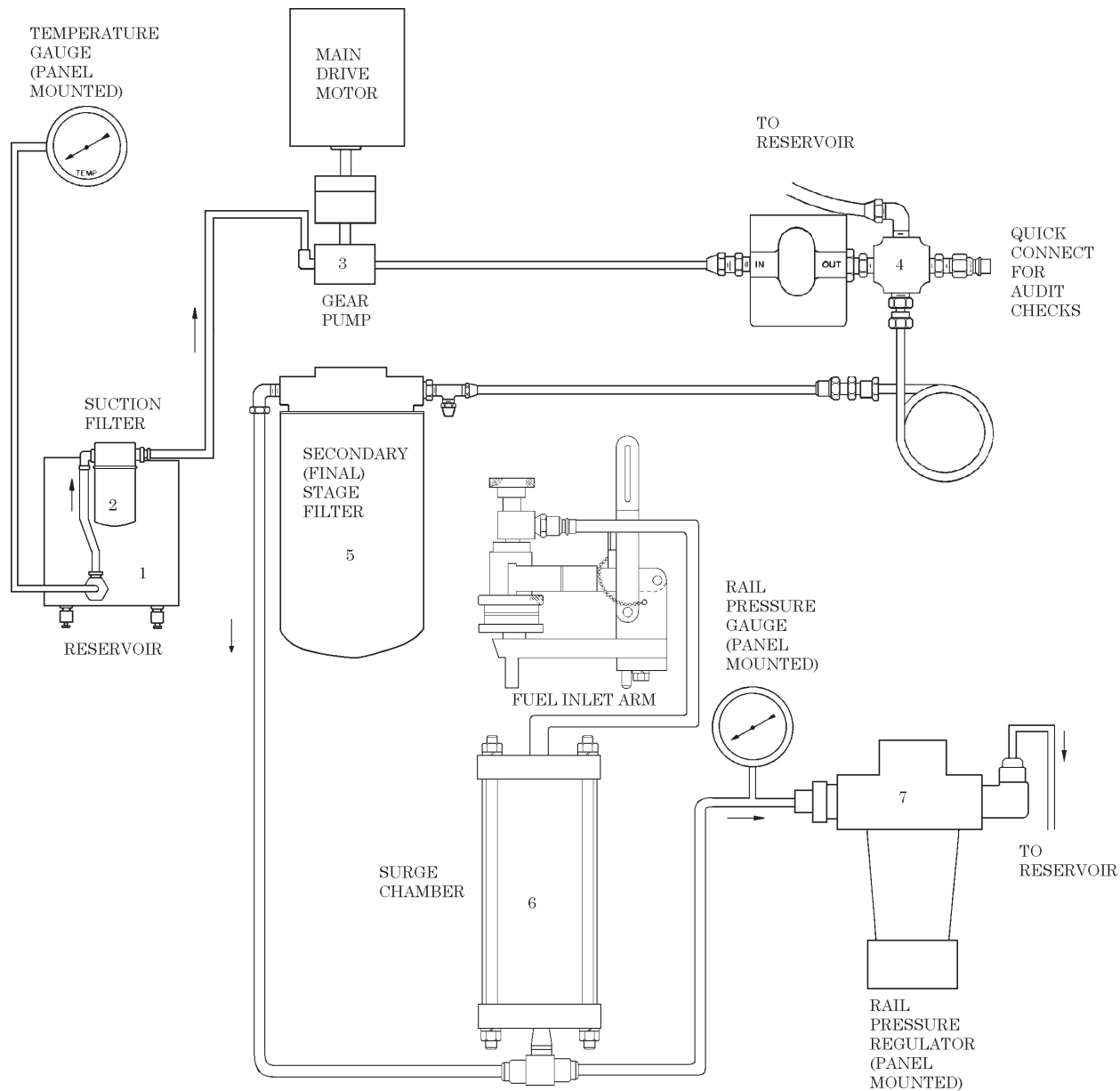


Figure 1-12. Injector Supply Circuit

**(c) Flowmeter Circuit (Injector Output)
(Figure 1-13)**

The flowmeter circuit begins at the discharge head which receives the injector output. Fluid passes through a strainer & orifice, and is routed to a 3-way solenoid valve (L8) controlled by a meter switch mounted on the control panel. When injector is running, before the switch is actuated, injector output is returned to the reservoir. When injector output reading is desired, the switch is actuated, injector output is routed through the flowmeter before it is returned to the reservoir. The metering system uses a patented positive displacement type flowmeter. Fluid drives a piston in a reciprocating motion controlled by two 3-way solenoid valves.

Motion of the piston, mechanically connected to a linear measurement device, produces signals which represent displaced volume. These signals and signals generated by camshaft rotation are electronically computed. Delivery is then digitally displayed in terms of mm³/stroke.

1.5 Calibration Fluid Temperature Control System (see Chapter 5)

Calibration fluid is supplied at the injector inlet to 104°F. Two 500 watt electric immersion heaters mounted in the reservoir heat the fluid. Cold water flowing through a coil of copper tubing mounted in the reservoir cools the fluid.

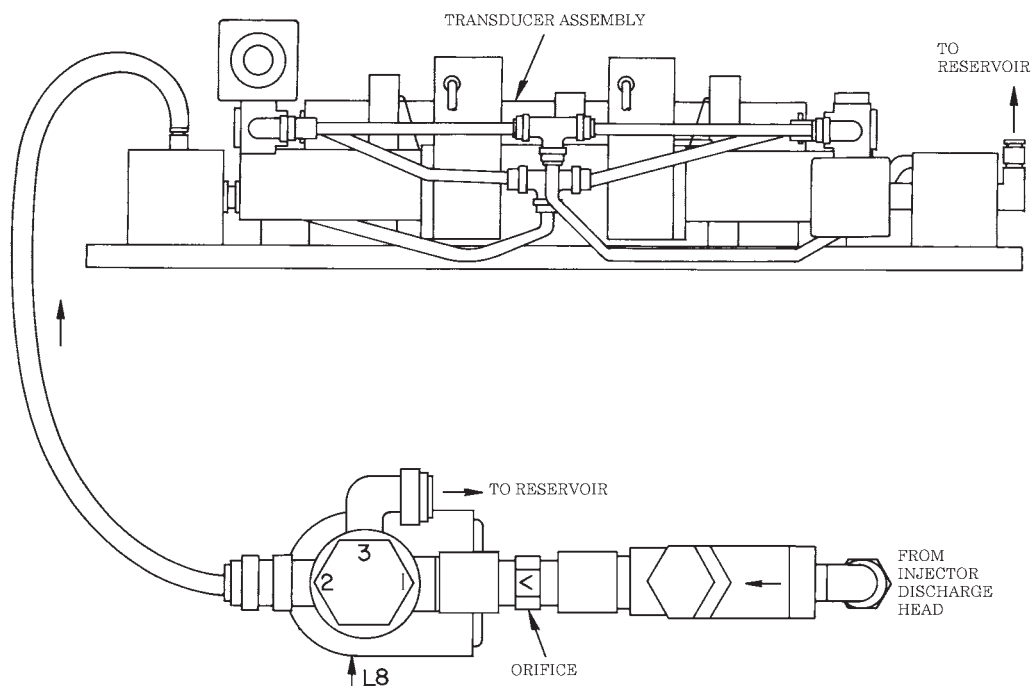


Figure 1-13. Flowmeter Circuit

A temperature sensor, mounted in the reservoir, is connected to a solid-state temperature controller, which either switches on the heaters or energizes the water solenoid valve (L1) to admit cold water to the cooling coil. A safety switch (S2) protects the system from overheating should the sensor fail.

The Hour Meter (HR1) is used to monitor the time calibration fluid has been maintained at specified temperatures by the Temperature Control System. Light (DS2) is “ON” during the heaters on cycle and “OFF” during the cooling cycle. Light (DS2) when monitored in conjunction with the CALIBRATION FLUID TEMPERATURE gauge is used to adjust the desired temperature with setting control R1.

Fluid temperature is kept stable through circulation provided by the continuously running gear pump in the clamping circuit (Figure 1-11).

1.6 Pneumatic System (Figure 1-14B)

Pneumatic system operates on shop supplied compressed air. Air pressure is needed for body to seat clamping operation and to power the intensifier.

On entering the system, shop air pressure at 95-125 psi is reduced to 90 psi by the Primary Air Pressure Regulator and 60 psi (4.1 bar) by the Secondary Air Pressure Regulator, complete with water trap,

filter, and gauge. The correct air pressure settings are made at the factory (and must be monitored by the operator). The Primary Air Pressure Regulator controls force exerted by the air cylinders for body to seat clamping of Cummins injectors. The Secondary Air Pressure Regulator controls hydraulic pressure of the intensifier assembly to unlock the hydraulic cylinder. Operation of the air clamping cylinders is controlled by two solenoid valves (L4, L5).

1.7 Electrical System (See Chapter 5)

The electrical system shown in the schematics in Chapter 5 includes the following safety interlocks:

- Motor will not start if pulley cover is not closed.
- If the operator accidentally presses the “BODY TO SEAT” (yellow) button or the “HOLD TO OPERATE” (green) button while the calibrator is running, no damage to the injector or the calibrator will occur.
- If the air pressure to the calibrator is lost, the main motor will stop.
- Body to seat clamping will occur only if the camshaft is in top dead center position, that is, when the white painted area of the flywheel is showing through the cambox cover window.

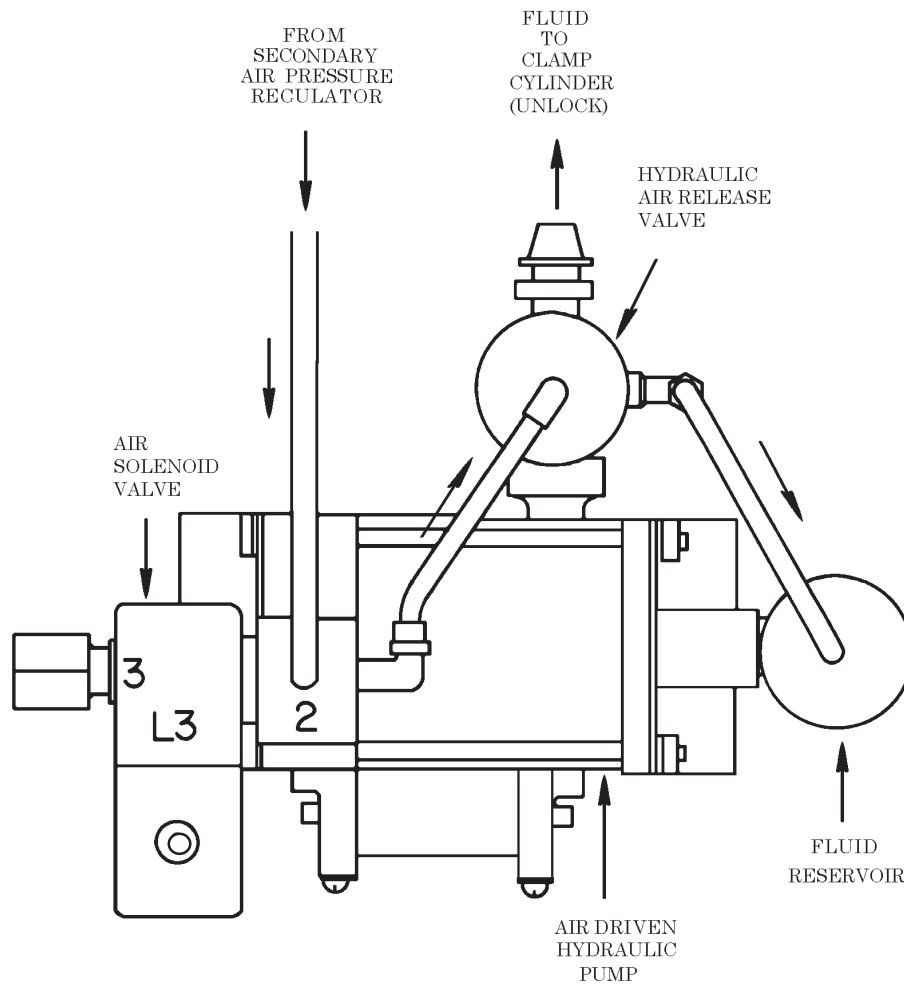


Figure 1-14A. Intensifier Assembly

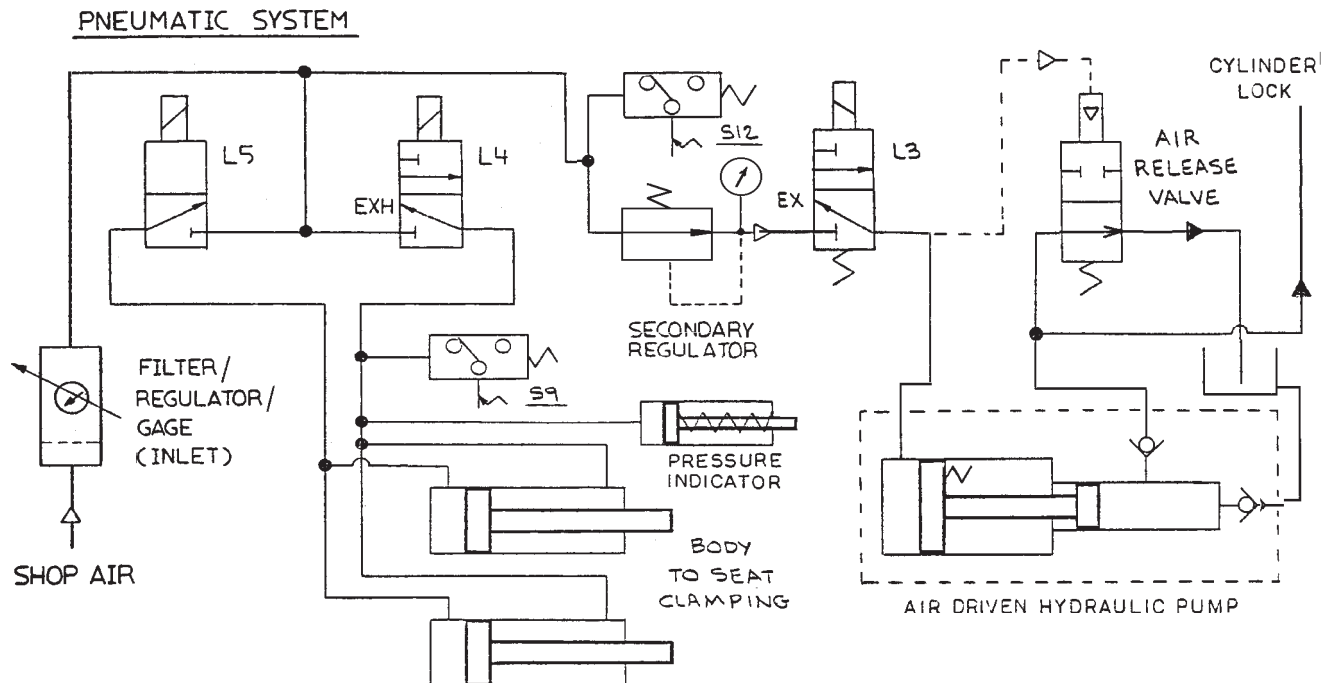


Figure 1-14B. Pneumatic System

2.0 INSTALLATION

2.1 Selecting the Site

Select an area where the calibrator will be level and on solid footing, plus convenient to shop air, cold water line, drain and electrical supply. Allow space around the unit for operation and maintenance. Allow for clearance of the cabinet doors and for easy removal of panels. If possible, locate the unit away from heavy vibrations and dusty or dirty atmosphere.

2.2 Hold Downs

For security in shipment, the main motor, flow-meter and console are bolted down and the motor mounting plate spring is completely compressed.

NOTE: The circled numbers shown with the labels on the photos refer to **step numbers** on the following instructions.

1. Open the left side hinged door and remove the panel in the rear of the console.
2. At the left side of the calibrator, loosen the top nuts on the motor mounting plate spring.
3. Remove the two shipping blocks from between the motor plate and the frame.
4. Adjust the spring tension to 3-3/4 inches.
5. Remove the two shipping spacers between the transducers base and console base by removing the two 1/4-20, 3/4 long bolts, nuts and washers.

NOTE: Save all removed (shipping) hardware for possible future moving or shipment.

6. Remove two shipping (wooden) spacers between the console and tabletop, located on each side of the console, by removing the two 1/4-20, 3/4 long bolts and washers.
7. Close the front doors and reinstall the rear panels.

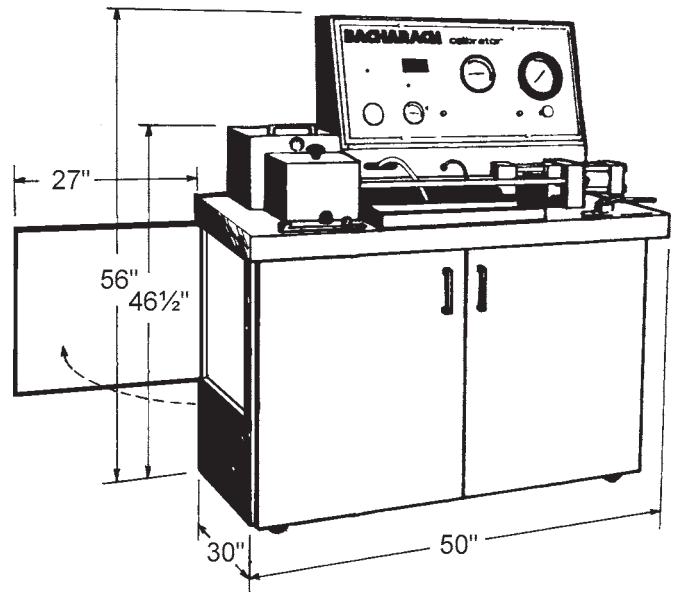


Figure 2-1. CD3 Dimensions

- ② Loosen Spring Nut ④ Adjust Spring to 3¾ in.

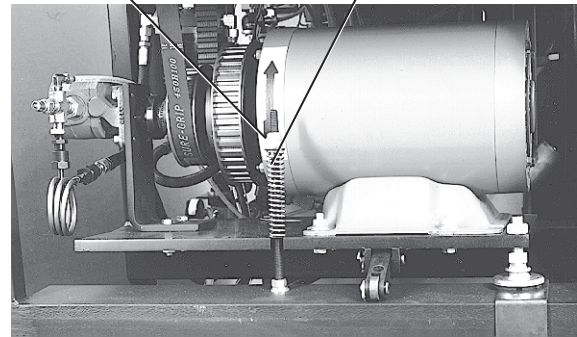
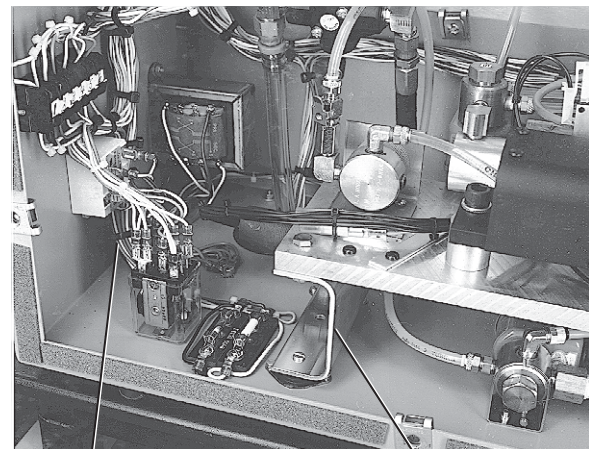


Figure 2-2. Spring Tension



- ⑥ Remove Console Bolt (typical both sides) ⑤ Remove Transducer Bolt (typical both sides)

Figure 2-3. Shipping Bolts

2.3 Utility Connections

Electrical

1. First, check the nameplate on the calibrator for electrical data. The plate is located behind the door on the left side of the calibrator to the left (on top of frame angle) beneath the motor.

Refer to Section "Technical Data" for information on required utilities.

2. Check that the On/Off Switch is OFF. Remove the lower left hand side panel covering the electrical box.
3. Wire the proper electrical power line to the motor starter in the electrical control box after punching appropriate hole.

CAUTION

CALIBRATOR CAN BE DAMAGED. If there is no fluid in the reservoir at this time, do not allow Clamp (circulating) pump or main drive motor to run more than a few seconds to check rotation.

4. After wiring, jog the main drive motor (turn On/Off Switch ON and OFF quickly) to check that the direction of rotation is the same as shown by the arrow on the motor.
5. If the motor direction is wrong, switch any two wires and check again. The motor must rotate counter clockwise as viewed from the drive end.

Water

6. Connect a cold water line to the fitting at the rear of the calibrator marked WATER IN (1/4 inch NPT).
7. Connect a drain line to the fitting marked WATER OUT (1/4 inch NPT).

NOTE: Do not install any valves, shutoffs or other restrictions on drain line. Water goes in under line pressure and must be free to run out.

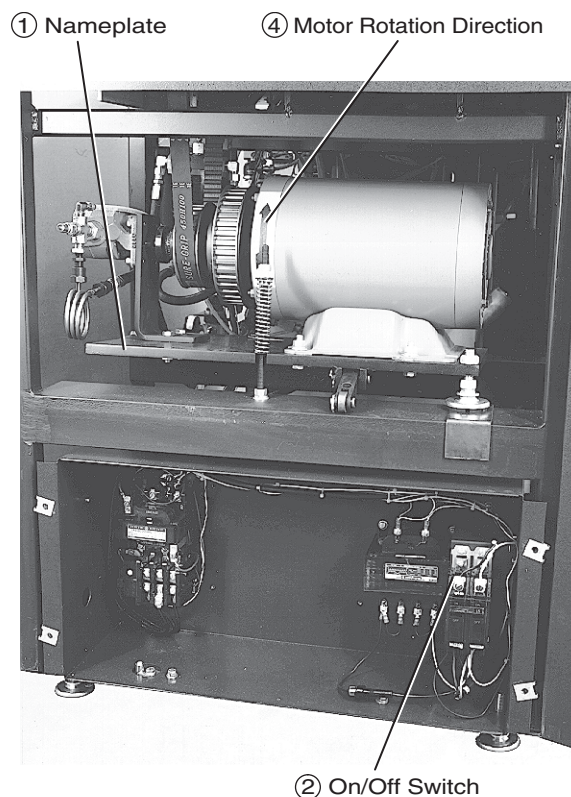


Figure 2-4. Electrical Connections

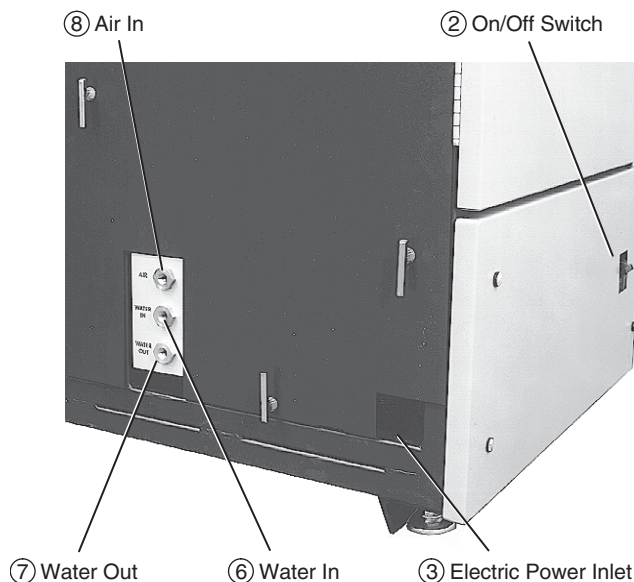


Figure 2-5. Water Connections

Air

8. Connect an air line from the shop supply (95 to 125 psi) to the fitting at the rear of the calibrator marked AIR (1/4 inch NPT).
9. Check regulator settings. The Primary Air Pressure Regulator should be set at 90 ± 5 psi, the Secondary Air Pressure Regulator must be set at $60 +5 -0$ psi (4.1 bar). The regulators are behind the lower rear panel.

CAUTION:

HIGH PRESSURE CAN DAMAGE AIR REGULATORS. Shop air supply must not exceed 125 psi.

10. For regulator adjustments see Section 4.3.2

2.4 Filling Reservoirs

Calibration Fluid

1. Check that both drains of the calibration fluid reservoir are closed.
2. Through the dipstick port, fill reservoir to the "F" mark on the dipstick with new fluid. Use Bacharach part number 67-5598 (SAE J967).
3. After a few minutes, check for leaks.
4. Place a tag on the reservoir giving date it was filled.

Cambox

The cambox is filled with lube oil at the factory. However, if filling is necessary:

5. Make sure cambox drain plug is in place. Drain plug is accessible after left-hand cab inlet door is open.
6. Fill the cambox with SAE 30W motor oil to bring the level up to within 3-3/4 inch from the top (or about 1-1/2 inch from the bottom).

Intensifier

7. The intensifier reservoir is filled at the factory before shipping. If additional fluid is required, see Section 2.6.

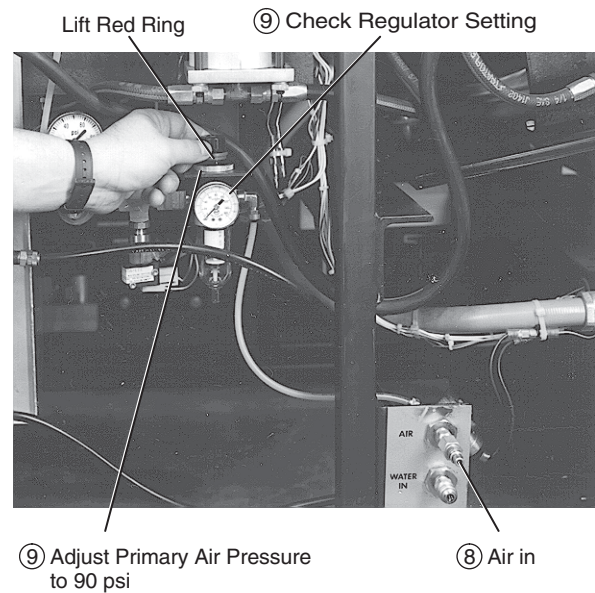


Figure 2-6. Air Connection

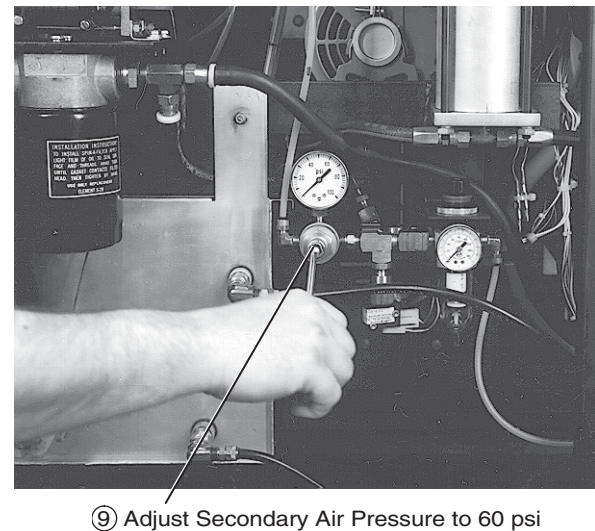


Figure 2-7. Adjust Air Pressure

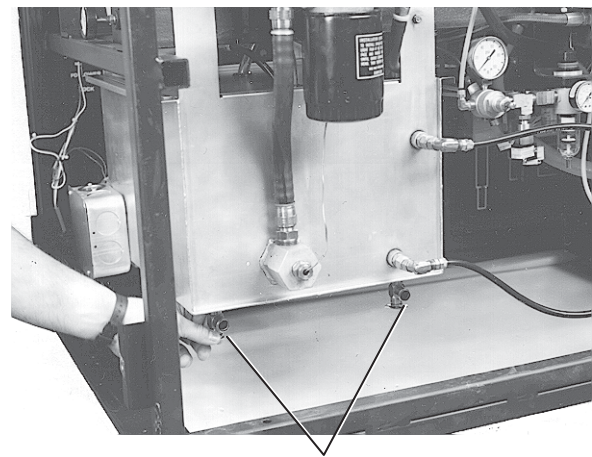


Figure 2-8. Calibration Drains

Flowmeter Transducer

8. The flowmeter transducer reservoir is filled at the factory before shipping. If additional fluid is required, see Section 2.6.

2.5 Pre-operation Checks

Before trying to operate the calibrator for the first time be sure to complete all the initial checks and start-up procedures given in Section 2.6.

CAUTION

*CALIBRATOR CAN BE DAMAGED. Do not operate the calibrator until all items on the check list in Section 2.6 have **YES** responses.*

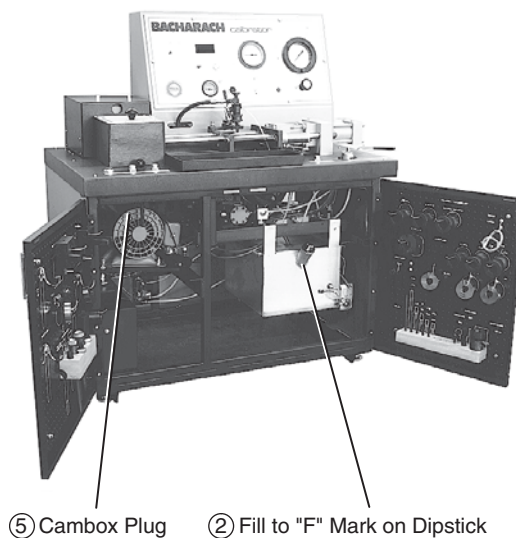
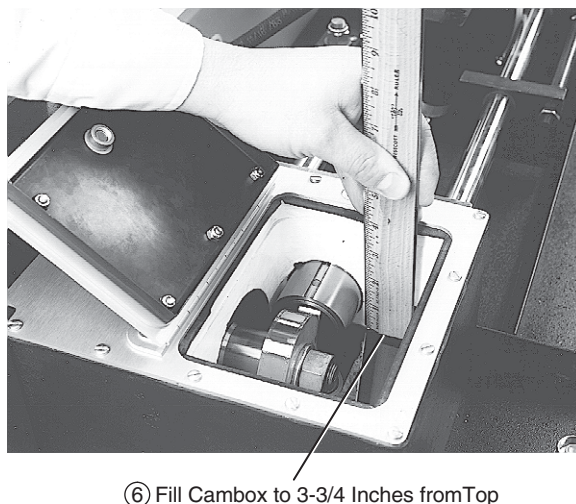


Figure 2-9. Calibration Fluid Dipstick



⑥ Fill Cambox to 3-3/4 Inches from Top

Figure 2-10. Checking Cambox

2.6 Initial Checks

Before operating the calibrator for the first time after installation, complete the following checklist. ALL RESPONSES SHOULD BE "YES".

PRE-OPERATION CHECKLIST

CONDITION	YES	NO
1. The On/Off Switch is in the OFF position.	_____	_____
2. The electrical power supplied corresponds to the data on the nameplate inside the left side door (See Section 2.3).	_____	_____*

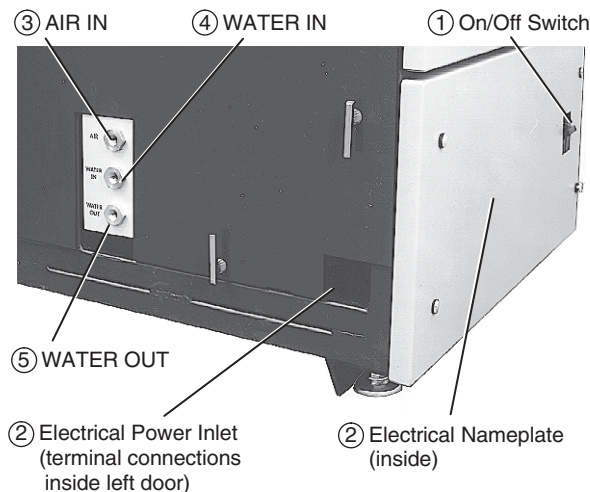


Figure 2-11. Initial Checks - Hookup

CONDITION	YES	NO
3. The air line from the shop air supply is connected to the AIR inlet at the back of the calibrator.	_____	_____
4. The cold water line is connected to the WATER IN port.	_____	_____
5. The drain line is connected to the WATER OUT port.	_____	_____
<p>NOTE: Do not connect any valve, shutoff, or other restriction in the drain line.</p>		
6. Inlet Air Pressure Regulator gauge. (Inside lower rear panel) indicates 90 ± 5 psi. Secondary Air Pressure Regulator must read 60 psi (4.1 bar) +5 -0 psi. Reset if necessary.	_____	_____
<p>NOTE: Air pressure regulators were set at the factory.</p>		
7. Both drain valves are closed on the calibration fluid reservoir.	_____	_____
8. The calibration fluid reservoir is filled to the "F" mark on the dipstick. Use Calibration Fluid P.N. 67-5598 (SAE J967).	_____	_____
9. The cambox is filled with oil to 3-3/4 inch from the top of cam box. If additional oil is required, use SAE 30W motor oil (non-detergent).	_____	_____

*If electrical power does **not** correspond to the data on the nameplate, consult the Bacharach factory.

(Checklist continued on next page)

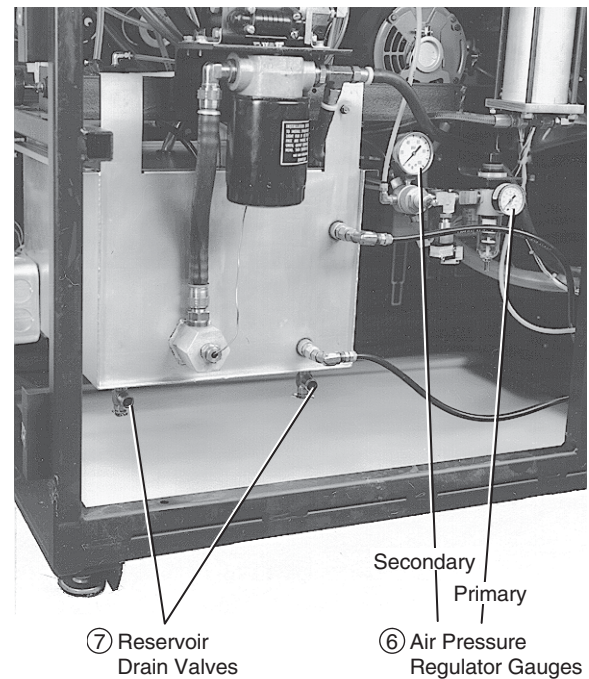


Figure 2-12. Initial Checks - Air Pressure

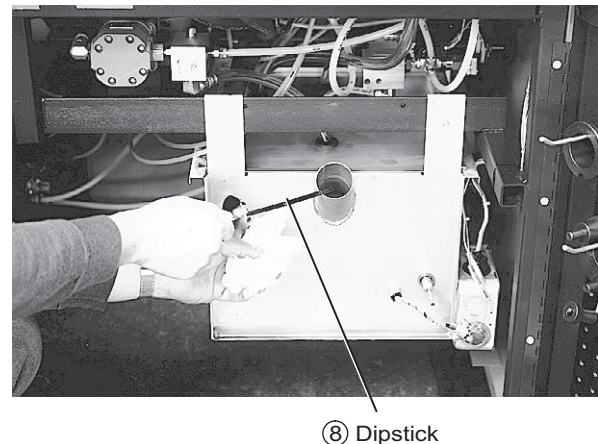


Figure 2-13. Initial Checks - Calibration Fluid

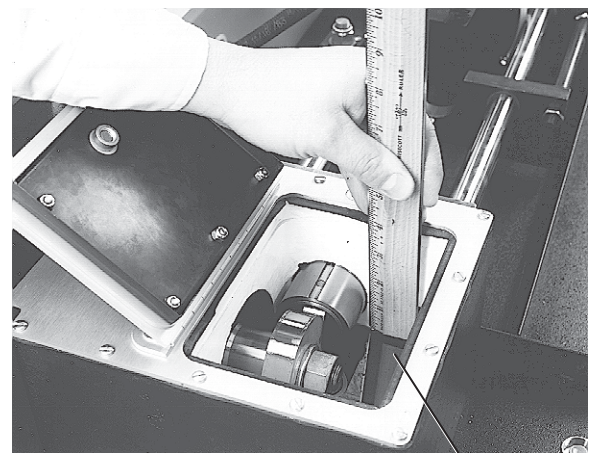


Figure 2-14. Initial Checks - Cambox Oil

CONDITION	YES	NO
10. The flowmeter cavity is filled with lube oil (10W30) to a level 3/8 inch from the bottom. Replenish if necessary. DO NOT OVERFILL.	_____	_____
11. The intensifier fluid reservoir is filled with oil. If additional oil is required, add SAE 10-W30 motor oil.	_____	_____

Do not proceed until all responses on the checklist are "YES".

2.7 Start-up

1. Switch the On/Off Switch on the left side of the calibrator to ON.

The POWER indicator, the HEATER indicator and the red dot on the display will be lit, and the circulating and clamp cylinder pump will be running.

2. Allow the calibrator to warm up until the CAL FLUID TEMPERATURE gauge indicates 104°F ±1°F (40°C). This usually takes about 15 to 20 minutes, depending on the ambient temperature.

The HEATER indicator light will be lit while the heater is on. When the fluid reaches the proper temperature, the light will go out.

3. The calibrator is now ready for testing injectors.

Follow procedures in Section 3.0 for Cummins and DD injectors.

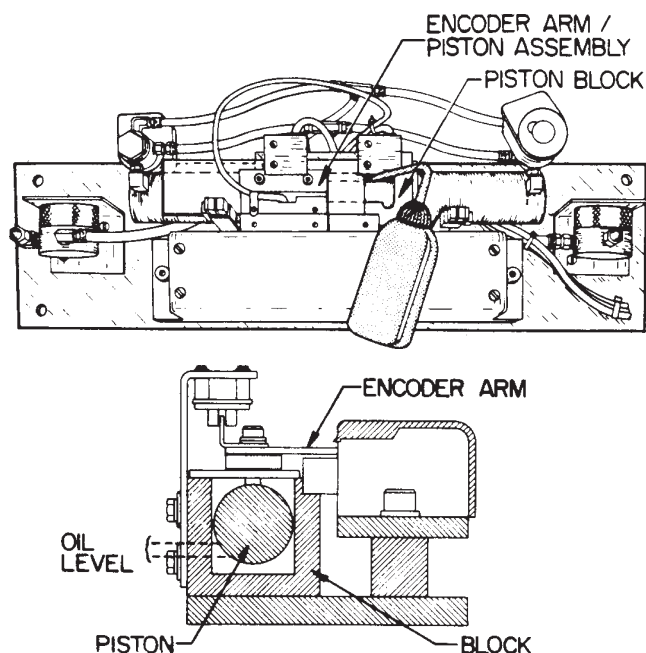


Figure 2-15 Initial Checks - Flowmeter Cavity

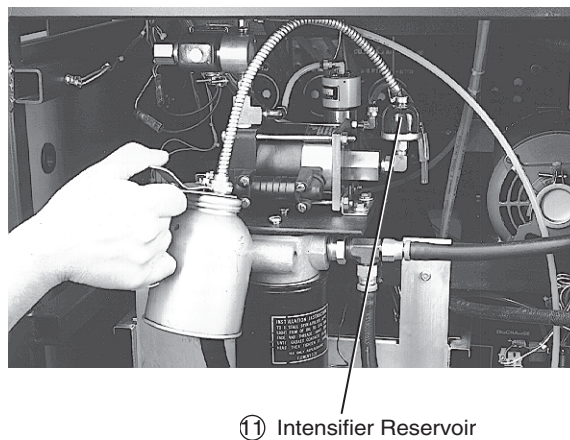


Figure 2-16. Initial Checks - Intensifier

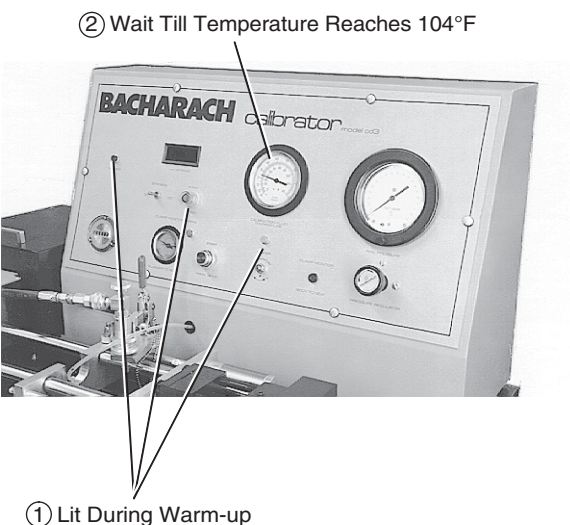


Figure 2-17. Start-up

2.8 Repacking for Shipping

1. Drain the calibration fluid reservoir from both drain valves.
2. Pack all the accessories listed in Section 5.2. Do not ship the calibrator with its accessories hanging on the door.
3. Disconnect all power and utilities. Drain water and blow out water lines by applying shop air pressure at the WATER OUT fitting. Plug both ports.
4. Displace Drive Motor belt so that it is hanging loose and not engaged on any pulley set.
5. Place 5/8 inch thick wooden blocks under each end of the drive motor mounting plate.
6. Tighten the main drive motor mounting spring until the motor is secure.
7. Place 5/8 x 7/8 x 11-1/2 inch wooden blocks under each side edge of the console.
8. Use a 3/4 inch long, 1/4-20 hex head cap screw in the center of each edge of the console to hold the console securely to the cabinet.
9. Install shipping blocks under the flowmeter transducer.
10. Use two 3/4 inch long, 1/4-20 bolts, nuts and washers to fasten the flowmeter transducer to the console.
11. Do not drain the fluid from the cambox.
12. Bolt the calibrator to a shipping skid.
13. Pack the calibrator in a sturdy container for shipping.

2.9 Shipping and Storage

1. Make sure the calibrator is kept upright during shipping and storage.
2. Do not drop or stack calibrators.
3. Store in a temperature and humidity controlled environment.

NOTES

3.0 OPERATION

3.1 Cummins Injectors

Cummins 189 cam (67-6370) is installed in the cambox at the factory. Other cams are packed with the Cummins accessories.

A complete set of Cummins Accessories is supplied under part number 67-7633 (Figure 5-14). The inside right front door of the calibrator has spaces designated for hanging Cummins accessories. Hooks are provided with the accessories.

NOTE: All parts are not shown in the photograph, check Chapter 5 (or the packing list) for a complete list of parts for the Cummins Accessories set.

All Cummins injectors require the same discharge head. This is a critical component in the measurement of injector fuel delivery. One of the main requirements of this component is that it incorporate a reliable check valve with good sealing characteristics and the correct pressure-flow rating.

NOTE: Do not change the setting of the adjusting screw on the discharge head. The discharge head was adjusted at the factory for proper flow characteristics and leakage, and can be adjusted only by using the Audit Kit (See Appendix A).

A push rod extension is used for all Cummins injectors. This extension fits between the end of the push rod and the injector link. It incorporates a plug and a shear pin for safety in case the link forces are excessive for any reason. Because the clamping cylinder rod can be locked at any position within its stroke, it is not necessary to have a different link for each PTD injector type.

3.1.1 Quick Reference Chart

This chart is for reference only. Use the procedures on the following pages for preparing the calibrator, accessories, and injectors for testing. For testing all Cummins injectors the camshaft speed must be 1050 RPM.

To change speed refer to Section 3.1.2. All Cummins injectors require accessories listed in the chart, plus 67-7642 Discharge Head, and 67-5706 Push Rod Extension. For all Cummins injectors the rail pressure must be exactly 100 psi.

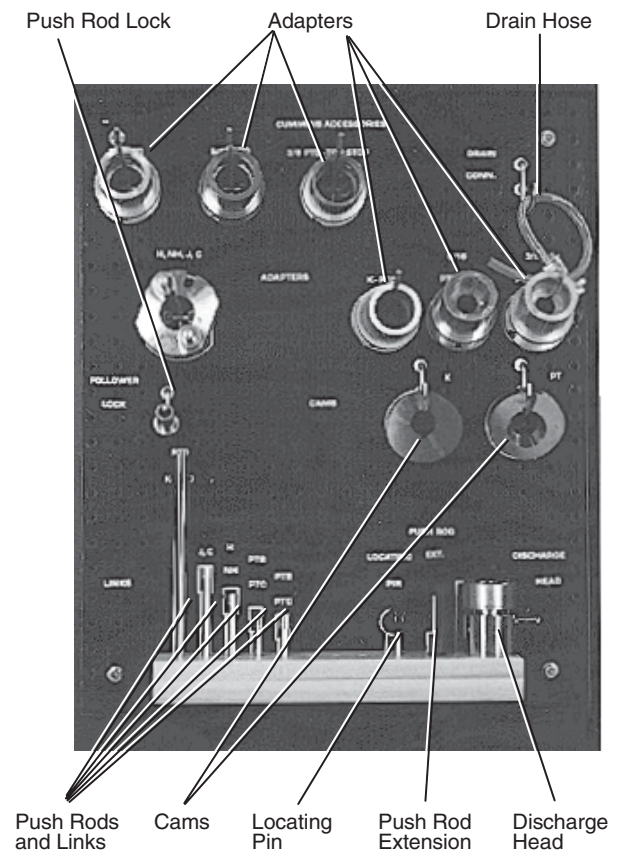


Figure 3-1. Cummins Injector Accessories

Cummins Accessory Part Number or Identification					
Injector Type	Adapter	Push Rod Link	Drain Connection	Locating Pin	Cam*
Flanged, H-NH	H-NH,J-C	H-NH	67-6580	—	189
Flanged, J-C	H-NH,J-C	J-C	67-6580	—	189
PTB, PTC 3/8	3/8 PTB-PTC	PTB-C	—	—	189
PTB, PTC 5/16	5/16 PTB-PTC	PTB-C	—	—	189
PTC 5/16 large radius link	5/16 PTB-PTC	PTC	—	—	189
PTD 3/8	3/8 PTD	67-5703	—	67-6519	189
PTD 5/16	5/16 PTD	67-5703	—	67-6519	189
PTD-K	K-PTD	67-5703	—	67-6519	310

(— means the accessory is not needed)

***THIS LIST IS A GUIDE ONLY.** For cam selection, refer to the latest Cummins Injector Specifications (Bulletin 3379664 latest issue). For a list of cams, see Section 3.1.3 and the Cummins Accessory Kit (67-7633).

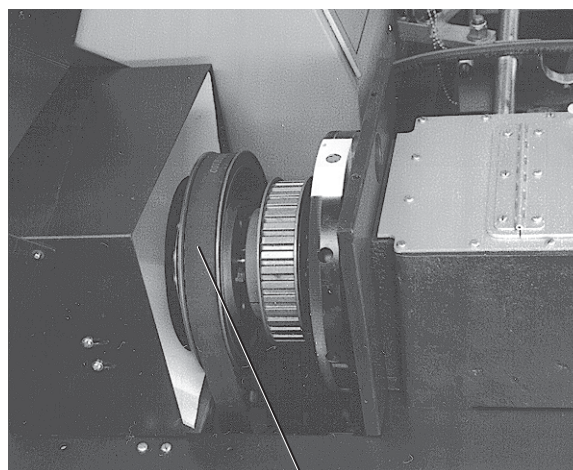
Figure 3-2. Cummins Injector Accessories Chart

3.1.2 Changing Speed

The CD3 calibrator is shipped with the drive belt disengaged. To change the speed setting to test Cummins:

1. Open the flywheel (sheave) cover to expose the upper pulleys.
2. Open the hinged door on the left side of the calibrator to expose the lower pulleys.
3. Insert barring tool into roller link assembly.
4. Push down on the barring tool to raise the motor enough to shift the drive belt from one set of pulleys to the other.
5. For 1050 RPM speed required for running the Cummins injectors, place drive belt over the larger diameter pulley on camshaft (top) and the matching pulley on motor shaft (bottom).
6. Make sure the shim (marked CUM) is under the leveler of the motor.
7. Lower the motor to its original position.

Next, check for proper cam installation (Section 3.1.3).



⑤ For Cummins Use Large Pulley

Figure 3-3. Pulley

3.1.3 Changing Cams

The cam is secured in place on the tapered end of the camshaft by a 3/4 in. hex nut and a 3/4 in. plain washer, and is locked to the shaft by a key.

When shipped from the factory, the calibrator has Cam 189 (67-6370) installed (used for most Cummins injectors). To change the cam:

1. Switch the power On/Off Switch to OFF.
2. Raise hinged lids of the cambox and flywheel.
3. Insert barring tool into one of the radial holes in the flywheel to hold camshaft in position.
4. Bar over flywheel until push rod is fully extended from cambox (cam at maximum lift).
5. Install push rod lock to hold the push rod when the cam is being removed.

NOTE: Failure to do so can lead to disengagement of follower parts and subsequent early failure of cambox.

6. Using a 1-1/8 in. box wrench, unscrew and remove the nut, washer and cam.
7. Select proper cam for the injector to be tested: Using Cummins service publications as a guide.

<u>Cam Part No.</u>	<u>Cam Identification</u>
67-6370	189
67-6369	310
67-6861	230
67-6870	169
77-0629	248
77-0823	272
77-0824	426

8. Fit the cam in place on the camshaft and make sure key in the cam is properly seated.

NOTE: It is a good practice to check that the cam does not wobble on the camshaft. If wobble exists, dress the camshaft where required as applicable.

9. Secure the cam with the washer and hex nut.
10. Remove pushrod lock.

The calibrator is now ready for inserting the discharge head, see Section 3.1.4.

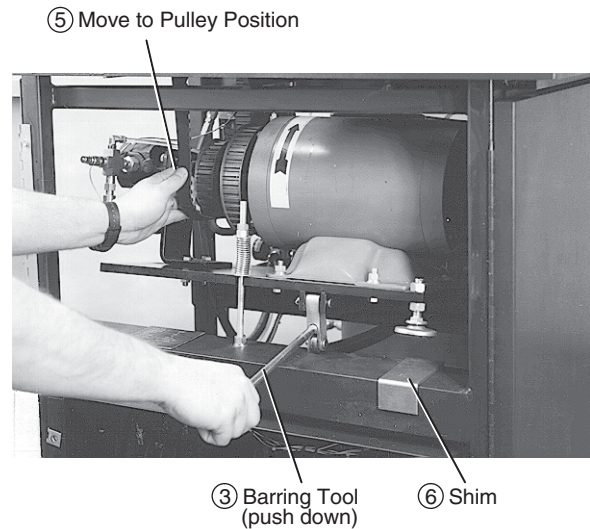


Figure 3-4. Changing Speed

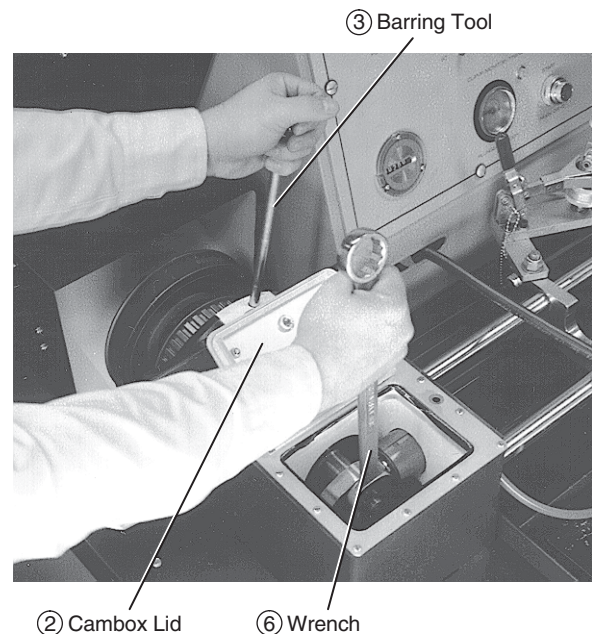


Figure 3-5. Changing Cams

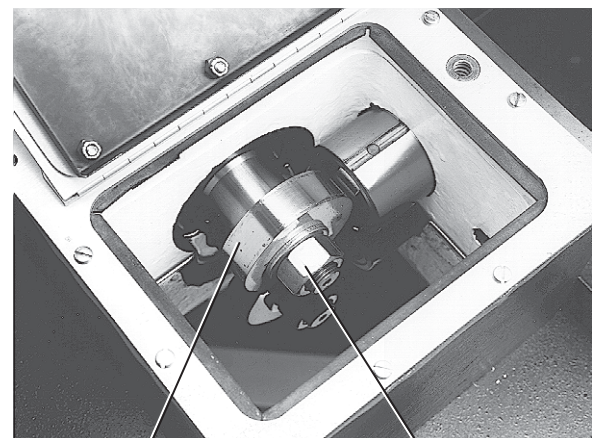


Figure 3-6. Cam & Hardware

3.1.4 Inserting Cummins Discharge Head

1. For all Cummins injectors, insert discharge head (67-7642) into the clamp cylinder socket, with the quick connect socket facing up.

NOTE: When discharge heads are installed for the first time, wet the O-ring with calibration fluid for easier installation.

2. Connect the tubing from the console to the discharge head.
3. Make sure spring-loaded lever on the quick connect is locked.
4. For all injectors except the PTD type, slide push rod extension (67-5706) over the push rod extending from the cambox so that the cut-off portion faces up.

Cummins injectors come in three general styles, each require specific accessories and procedures:

Type PTD cylindrical	Section 3.1.5
Types PTB & PTC cylindrical	Section 3.1.6
Cummins Flanged	Section 3.1.7

Following the mounting procedures for the style injector you have.

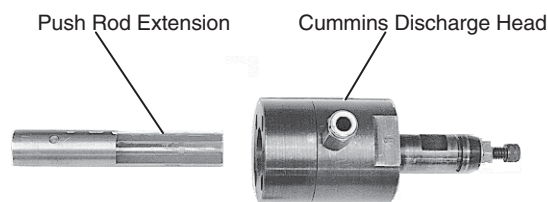


Figure 3-7. Discharge Head & Push Rod Extension

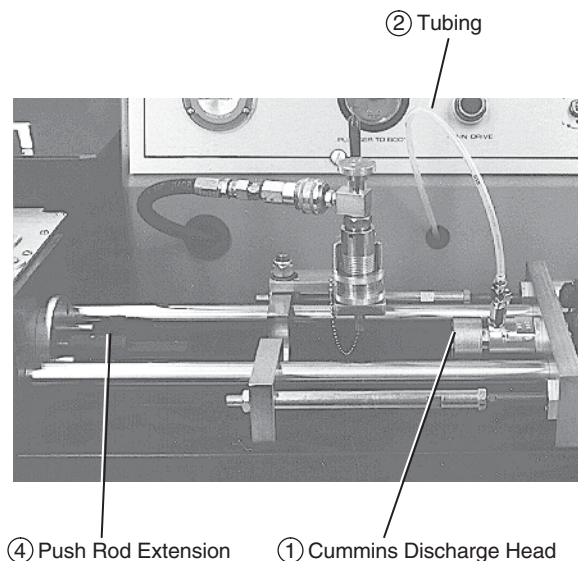


Figure 3-8. Inserting Discharge Head

3.1.5 Mounting Cummins Type PTD Cylindrical Injectors

Before mounting injectors, check in the cambox to be sure that the proper cam for the injector to be tested is mounted on the camshaft. (See Section 3.1.3)

Also make sure the Cummins discharge head has been installed. (See Section 3.1.4)

3.1.5.1 Inserting Injectors

1. Insert injector into the correct PTD adapter.

<u>Injector</u>	<u>Adapter</u> <u>Part No.</u>	<u>Ident.</u>
PTD 3/8	67-6348	3/8 PTD
PTD 5/16	67-6350	5/16 PTD
PTD-K	67-6351	K-PTD
PTD top stop	67-6349	PTD-TS
PTD top stop (L-10)	67-6972	L-10
PTD K-HVT	67-6997	K-HVT
PTD STC	77-0891	STC

(The PTD (L-10) and PTD K-HVT adapters do not appear in the photo of Cummins accessories, see Section 5.14)

2. With adapter slot facing down and the injector inlet orifice facing up, align injector body drain hole with corresponding hole in the adapter.
3. Insert locating pin (67-6519).
4. Insert link (67-5703) into injector.
5. Hold these parts in two hands and lower them into the carrier plate, making sure that:
 - a. The adapter slot aligns with the protruding 3/8 in. pin.
 - b. The adapter rests against the semicircular area of the carrier plate.
 - c. The link is pushed over the push .

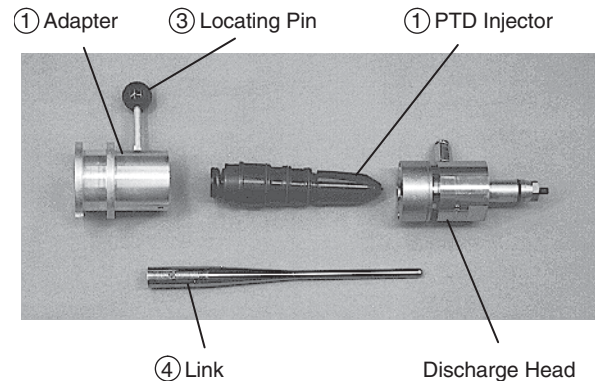


Figure 3-9. PTD Accessories

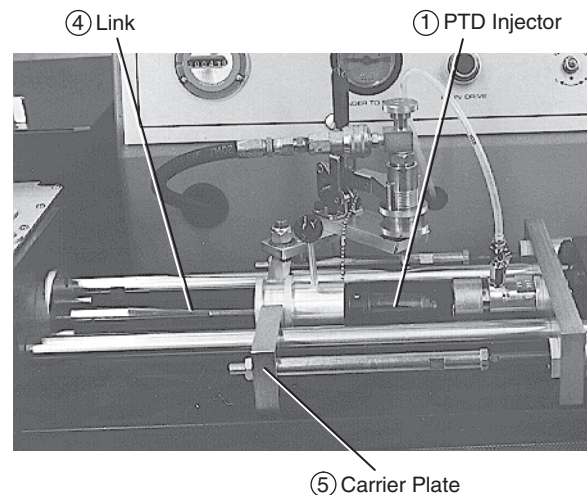


Figure 3-10. Injector Setup

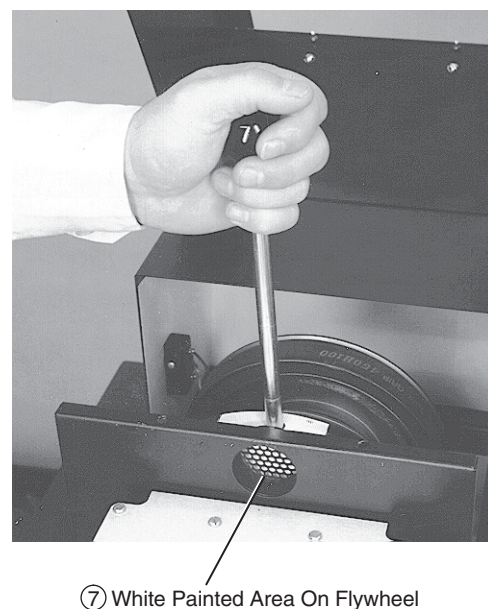


Figure 3-11. Setting Flywheel

3.1.5.2 Clamping Body to Seat

6. Lift the pulley cover to expose the camshaft pulleys and flywheel.
7. Rotate flywheel by hand until the white painted area on the flywheel shows through the window (the barring tool inserted in a hole in flywheel can help in turning the flywheel).

NOTE: *If the painted area does not appear in the window, body to seat clamping can not be accomplished.*

8. Close the pulley cover. Cover must be closed for the main drive motor to operate.
9. To clamp the injector, press and hold down the HOLD TO OPERATE button.
10. Press the BODY TO SEAT CLAMP button.

The air cylinders will retract and clamp the injector.

11. Release BODY TO SEAT CLAMP button when the BODY TO SEAT monitor turns green.

3.1.5.3 Clamping Plunger to Body

CAUTION

*Clamping force influences fuel delivery.
Follow these instructions carefully.*

12. Continue to hold the HOLD TO OPERATE button with left hand.
13. While holding down the HOLD TO OPERATE button, move the CLAMP/UNCLAMP lever to the CLAMP position with right hand.

Maximum clamping force shown on the CLAMP MONITOR/TIMING plunger to body gauge will be in the green segment and TIMING light will be lit.

14. Wait until the plunger to body TIMING light goes out (after about 3 seconds).

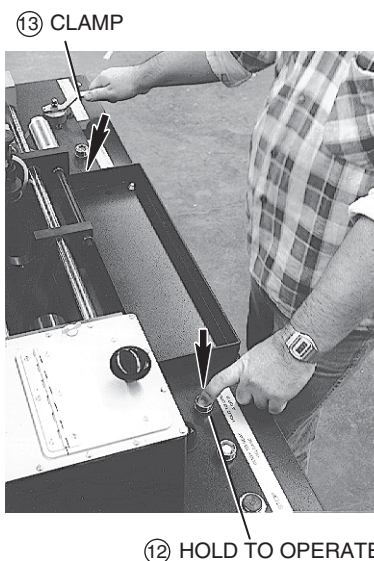


Figure 3-12. Body to Seat Clamp

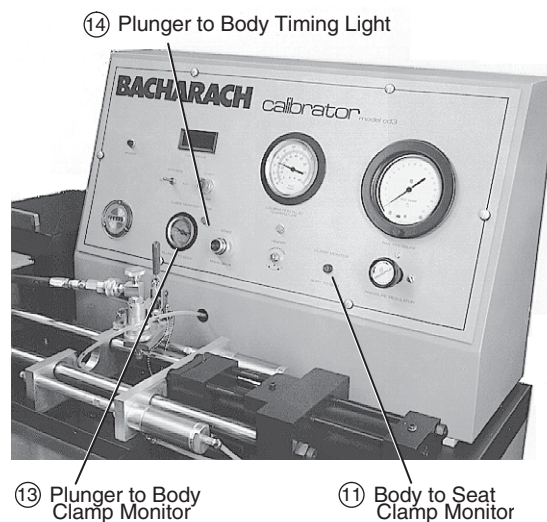


Figure 3-13. Timing Light & Clamp Monitors

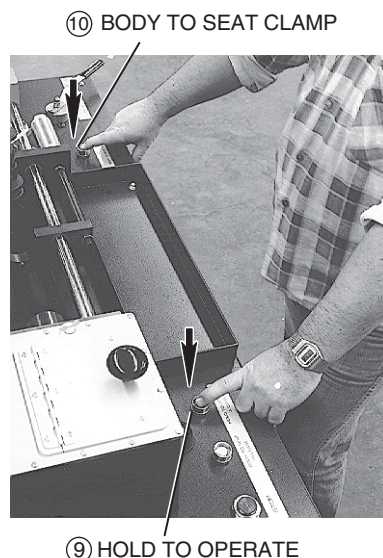


Figure 3-14. Plunger to Body Clamp

15. Release the HOLD TO OPERATE button **first** and **then** the CLAMP/UNCLAMP lever. The lever will return to the center position.

For clamping to occur correctly, you must follow this sequence.

The clamp monitor reading will decrease from the green segment of the dial to a lower reading (red segment) immediately after the CLAMP/UNCLAMP valve lever is returned to the center position.

3.1.5.4 Connecting Fuel Arm

NOTE: When first using the fuel arm, make sure the O-ring is in place at the end of the fuel arm. This can be done by using a small mirror. If it is necessary to disassemble fuel arm, see Troubleshooting Guide (Section 4).

16. Make sure that the inlet fuel connector (round knurled knob) is tightly secured to the fuel arm assembly.
17. Swing the fuel arm into place over the injector.
18. Lower the connector tube over the inlet orifice by moving the toggle clamp fully forward (toward you) so it locks.
19. Adjust the fuel arm positioning as required to obtain a leak free connection.

CAUTION:

To prevent being sprayed with calibration fluid, make sure the fuel arm rests vertically against the inlet orifice (with the O-ring seal in place) and is not being pulled sideways by the inlet hose.

The injector is now ready for testing (Section 3.1.8).

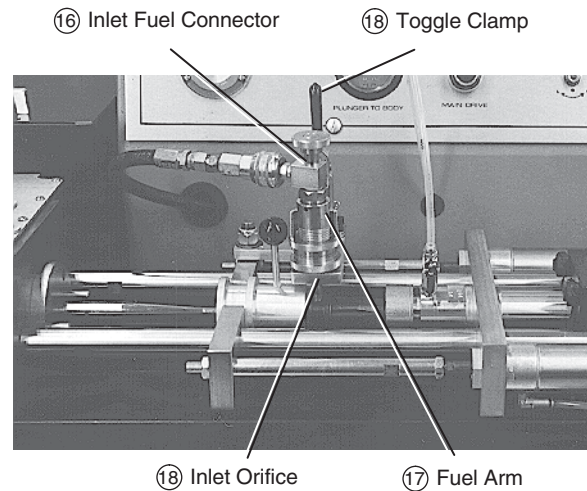


Figure 3-15. Injector Clamped

3.1.6 Mounting Cummins Types PTB and PTC Cylindrical Injectors

Before mounting injectors, check cambox to be sure that the proper cam for the injector to be tested is mounted on the camshaft. (See Section 3.1.3)

Also make sure the Cummins discharge head has been installed. (See Section 3.1.4)

3.1.6.1 Inserting Injectors

1. Pull out the plunger and spring from the injector.
2. Insert the injector into the correct PTB or PTC adapter.

<u>Injector</u>	<u>Adapter Part No.</u>	<u>Ident.</u>
PTB, PTC 3/8	67-6604	3/8 PTB-PTC
PTB, PTC 5/16	67-6602	5/16 PTB-PTC
PTC 5/16 large radius link	67-6602	5/16 PTB-PTC

3. Align the injector with the socket screw head in the adapter.
4. Reinstall the plunger with the spring into the injector from the opposite end of the adapter.
5. Insert the PTB-C or the PTC lg. rad. link into the plunger.
6. Hold these parts in two hands and lower them into the carrier plate, making sure that:
 - a. The adapter slot aligns with the protruding 3/8 in. pin.
 - b. The adapter rests against the semicircular area of the carrier plate.
 - c. The link rests on top of the push rod extension.

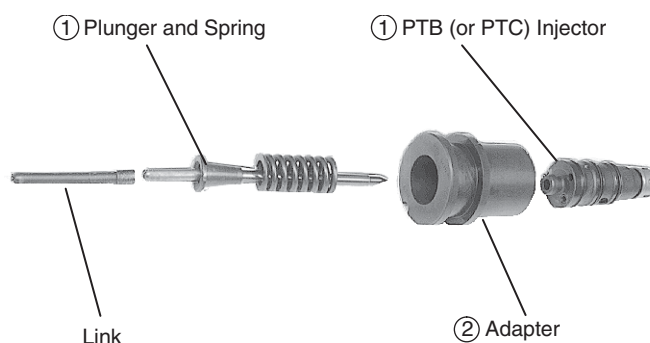


Figure 3-16. PTB & PTC Accessories

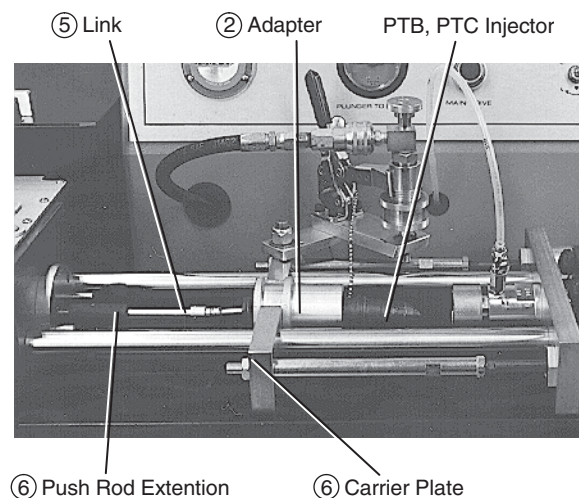


Figure 3-17. Injector Setup

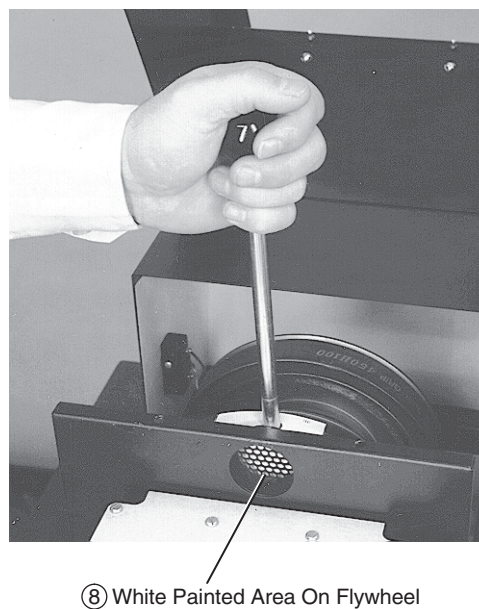


Figure 3-18. Setting Flywheel

3.1.6.2 Clamping Body to Seat

7. Lift the pulley cover to expose the camshaft pulleys and flywheel.
8. Rotate flywheel by hand until the white painted area on the flywheel shows through the window (barring tool inserted in a hole in the flywheel can help in turning the flywheel).

NOTE: *If the painted area does not appear in the window, body to seat clamping can not be accomplished.*

9. Close the pulley cover. Cover must be closed for the main drive motor to operate.
10. To clamp the injector, press and hold down the HOLD TO OPERATE button.
11. Press the BODY TO SEAT CLAMP button.

The air cylinders will retract and clamp the injector.

12. Release the BODY TO SEAT CLAMP button when the BODY TO SEAT monitor turns green.

3.1.6.3 Clamping Plunger to Body

CAUTION

*Clamping force influences fuel delivery.
Follow these instructions carefully.*

13. Continue to hold the HOLD TO OPERATE button with left hand.
14. While holding down the HOLD TO OPERATE button, move the CLAMP/UNCLAMP lever to the CLAMP position with right hand.

The maximum clamping force shown on the CLAMP MONITOR/TIMING PLUNGER TO BODY gauge will be in the green segment and the timing light will be lit.

15. Wait until the PLUNGER TO BODY timing light goes out (after about 3 seconds).

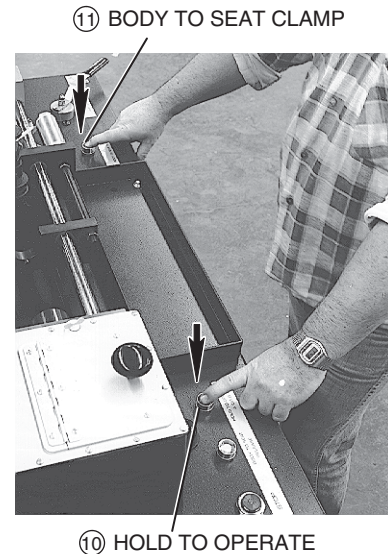


Figure 3-19. Body to Seat Clamp

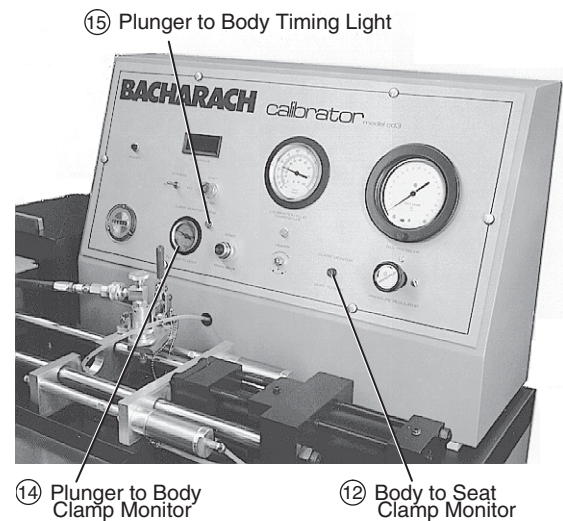


Figure 3-20. Timing Light & Clamp Monitors

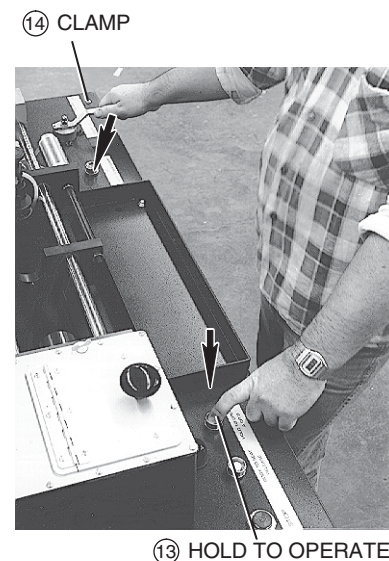


Figure 3-21. Plunger to Body Clamp

16. Release the HOLD TO OPERATE button **first** and **then** the CLAMP/UNCLAMP lever. The lever will return to the center position.

For clamping to occur correctly, you must follow this sequence.

The gauge reading will decrease from the green segment of the dial to a lower reading (red segment) immediately after the CLAMP/UNCLAMP valve lever is returned to the center position.

3.1.6.4 Connecting Fuel Arm

NOTE: When first using the fuel arm, make sure the O-ring is in place at the end of the fuel arm. If the O-ring must be replaced, see Troubleshooting Guide in Section 4.

NOTE: Some early style PTB and PTC injectors may have to be reworked to provide for the button head inlet orifice. Unless reworked, they cannot be tested with these accessories.

17. Make sure that the inlet fuel connector (round knurled knob) is tightly secured to the fuel arm assembly.
18. Swing the fuel arm into place over the injector.
19. Lower the connector tube over the inlet orifice by moving the toggle clamp fully forward (toward you) so it locks.
20. Adjust the fuel arm positioning as required to obtain a leak free connection.

CAUTION:

To prevent being sprayed with calibration fluid, make sure the fuel arm rests vertically against the inlet orifice (with the O-ring seal in place) and is not being pulled sideways by the inlet hose.

The injector is now ready for testing (Section 3.1.8).

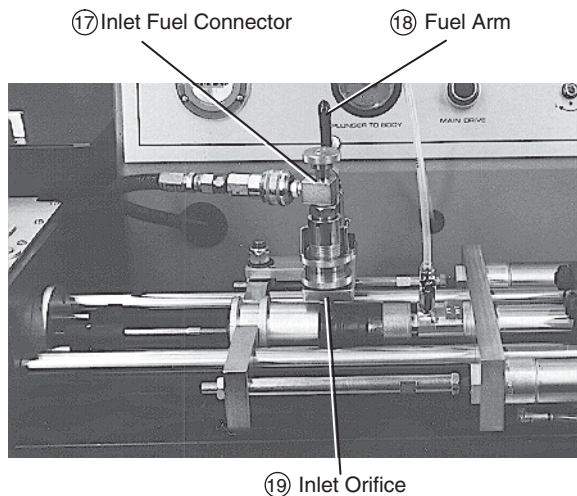


Figure 3-22. Injector Clamped

3.1.7 Mounting Cummins Flanged Injectors

Before mounting injectors, check cambox to be sure that the proper cam for the injector to be tested is mounted on the camshaft. (See Section 3.1.3)

Also make sure the Cummins discharge head has been installed. (See Section 3.1.4)

3.1.7.1 Inserting Injectors

1. Insert the injector into adapter H-NH, J-C (67-6368) so that the flanged body holes slip over the two pins.
2. Align the injector so that the injector outlet and inlet ports face the operator and the slots in the adapter face down.
3. Select the correct link and insert it into the plunger.

<u>Injector</u>	<u>Part No.</u>	<u>Ident.</u>
Flanged, H-NH	67-6575	H-NH
Flanged, J-C	67-6576	J-C

4. Hold these parts in two hands and lower them into the carrier plate, making sure that:
 - a. The adapter slot aligns with the protruding 3/8 in. pin.
 - b. The adapter rests against the semicircular area of the carrier plate.
 - c. The link rests on top of the push rod extension.

3.1.7.2 Clamping Body to Seat

5. Lift the pulley cover to expose the camshaft pulleys and flywheel.
6. Rotate flywheel by hand until the white painted area on the flywheel shows through the window (barring tool inserted in a hole in the flywheel can help in turning the flywheel).
7. Close the pulley cover. Cover must be closed for the main drive motor to operate.
8. To clamp the injector, press and hold down the HOLD TO OPERATE button

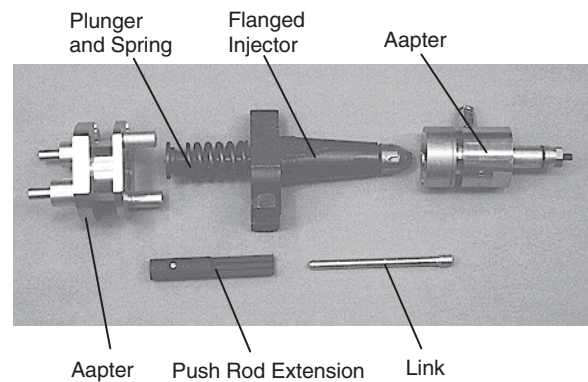


Figure 3-23. Flanged Injector Accessories

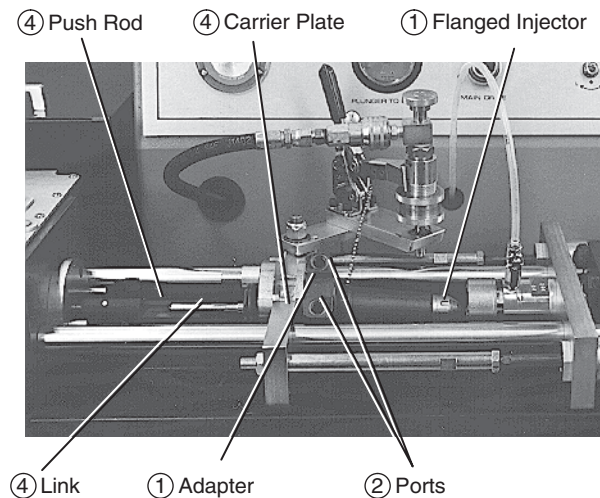


Figure 3-24. Injector Setup

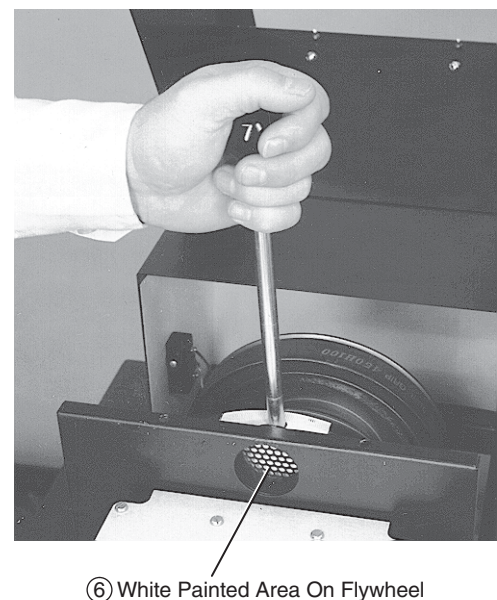


Figure 3-25. Setting Flywheel

9. Press the BODY TO SEAT CLAMP button.

The air cylinders will retract and clamp the injector.

10. Release the BODY TO SEAT CLAMP button when the BODY TO SEAT monitor turns green.

3.1.7.3 Clamping Plunger to Body

CAUTION

*Clamping force influences fuel delivery.
Follow these instructions carefully.*

11. Continue to hold the HOLD TO OPERATE button with left hand.
12. While holding down the HOLD TO OPERATE button, move the CLAMP/UNCLAMP lever to the CLAMP position with right hand.

The maximum clamping force shown on the CLAMP MONITOR/TIMING PLUNGER TO BODY gauge will be in the green segment and the timing light will be lit.

13. Wait until the PLUNGER TO BODY timing light goes out (after about 3 seconds).
14. Release the HOLD TO OPERATE button **first** and **then** the CLAMP/UNCLAMP lever. The lever will return to the center position.

For clamping to occur correctly, you must follow this sequence.

The gauge reading will decrease from the green segment of the dial to a lower reading (red segment) immediately after the CLAMP/UNCLAMP valve lever is returned to the center position.

3.1.7.4 Connecting Fuel Inlet

15. With the flanged injector clamped in position, disconnect the fuel inlet connector from the fuel arm.
16. Swing the arm towards the console.

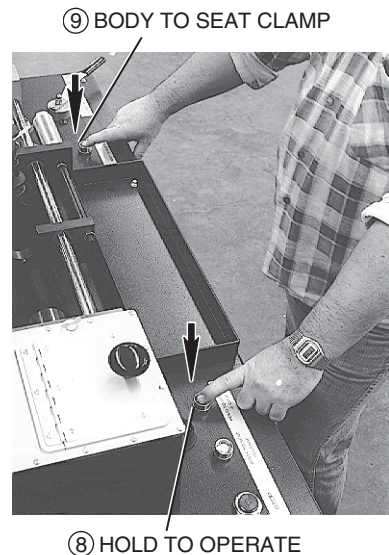


Figure 3-26. Body to Seat Clamp

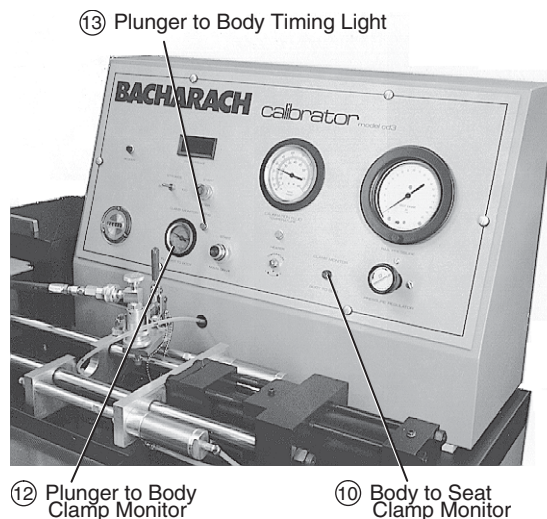


Figure 3-27. Timing Light & Clamp Monitors

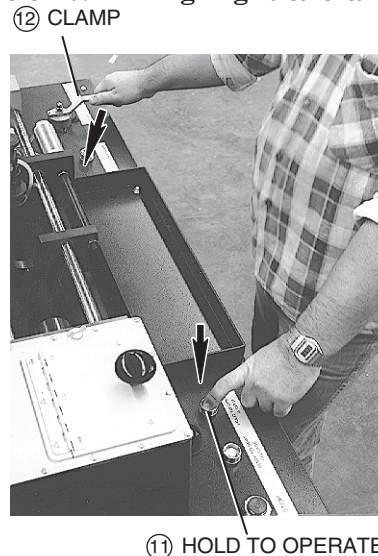


Figure 3-28. Plunger to Body Clamp

17. Connect the fuel inlet connector (using a Teflon O-ring) to the injector inlet port (the inlet orifice in the injector is visible).
 18. Use the drain hose connector assembly (67-6580) to connect to the injector return port.
 19. Insert the hose into the hole of the drain pan.
- The injector is now ready for testing (Section 3.1.8).

3.1.8 Testing

WARNING:

HAZARDOUS ROTATING MACHINERY. Do not open cambox cover while main drive motor is running.

NOTE: When starting main drive for the first time, run it for only a few seconds after pressure develops to make sure that all fuel connections are tight.

1. Press the START MAIN DRIVE button.

NOTE: If main drive motor won't start, check the pulley cover. It must be tightly closed for the interlock safety switch to allow the main drive motor to operate.

2. Wait until trapped air escapes from the discharge head through the plastic tubing leading to the meter. Rapid chattering indicates that air is trapped in the tubing.
3. Check fuel pressure on the RAIL PRESSURE gauge. It must be exactly 100 psi. If the RAIL PRESSURE is above or below 100 psi, adjust it by turning the Rail PRESSURE REGULATOR and relocking the nut on the stem.
4. Set the STROKE selector on 50.
5. Press START METER on the console. The light in the button will come on.

The MM³/STROKE delivery display will show cumulative readings until 50 strokes are completed. At that time the reading will stay on until the next update which is after 50 strokes when the red dot will flash. Readings will be updated automatically every 50 strokes.

6. Observe the LED display and record fuel output readings.

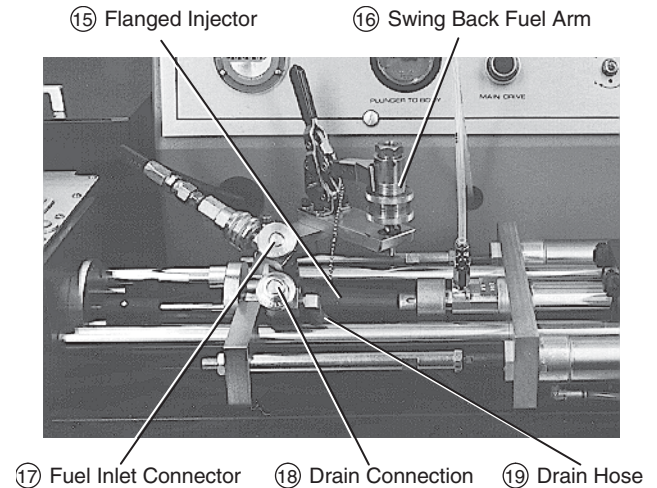


Figure 3-29. Injector Clamped

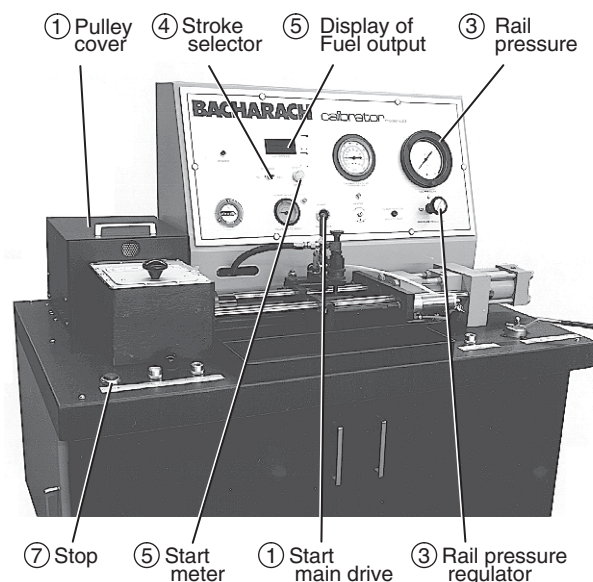


Figure 3-30. Testing Injectors

The reading is in mm³/stroke, which is equivalent to cm³/1000 strokes (cc/1000 strokes). During a test run, if a change over is made from 50 to 100 stroke setting, or vice versa, ignore the next reading

7. When the test is over, press the STOP button on the left hand operator's table.

3.1.9 Unclamping

1. Disconnect the fuel inlet.
2. Press and hold the HOLD TO OPERATE button.
3. While holding the button down, move the CLAMP/UNCLAMP lever to the UNCLAMP position and let the hydraulic cylinder completely retract.
4. Release the HOLD TO OPERATE push-button and allow the CLAMP/UNCLAMP lever to return to its center position.
5. Press the BODY TO SEAT RELEASE button, and hold down until the BODY TO SEAT green indicator retracts.



Figure 3-31. Unclamping Injectors

3.1.10 Removing Injectors & Shutting Down

1. Disconnect the fuel inlet hose from the injector holder or manifold.
2. Remove injector and accessories from the calibrator.
3. Replace accessories on inside cabinet door.
4. Disconnect flowmeter tubing from discharge head.
5. Remove discharge head and store inside the cabinet door.
6. Remove cam and store inside the cabinet door.

NOTE: *Discharge head and cam can be left installed on the calibrator if desired.*

7. Turn off power at On/Off Switch at lower left side of calibrator.
8. Wipe oil spills and splashes from console and operator's table.

3.2 Detroit Diesel (DD) Injectors

Cummins 189 cam (67-6370) is installed in the cambox at the factory.

A complete set of DD accessories is supplied under part number 67-7632 (Figure 5-15). The inside left front door of the calibrator has spaces designated for hanging DD accessories (Figure 3-32). Not all of the DD accessories are shown in this photo. Hooks are provided with the accessories.

DD Injectors are clamped against a manifold or spacer between the injector and cambox. Supports are required for the front of the injector. On DD 149 injector, a push rod extension is used between the push rod and the injector follower. The 8.2 liter injector needs a special holder assembly.

3.2.1 Quick Reference Charts for Testing Injectors

This chart is for reference only. Use the procedures on the following pages for preparing the calibrator, accessories, and injectors for testing.

For testing all DD injectors the camshaft speed must be 2000 RPM. To change speed see Section 3.2.2. For DD injectors, rail pressure must be 35 psi.

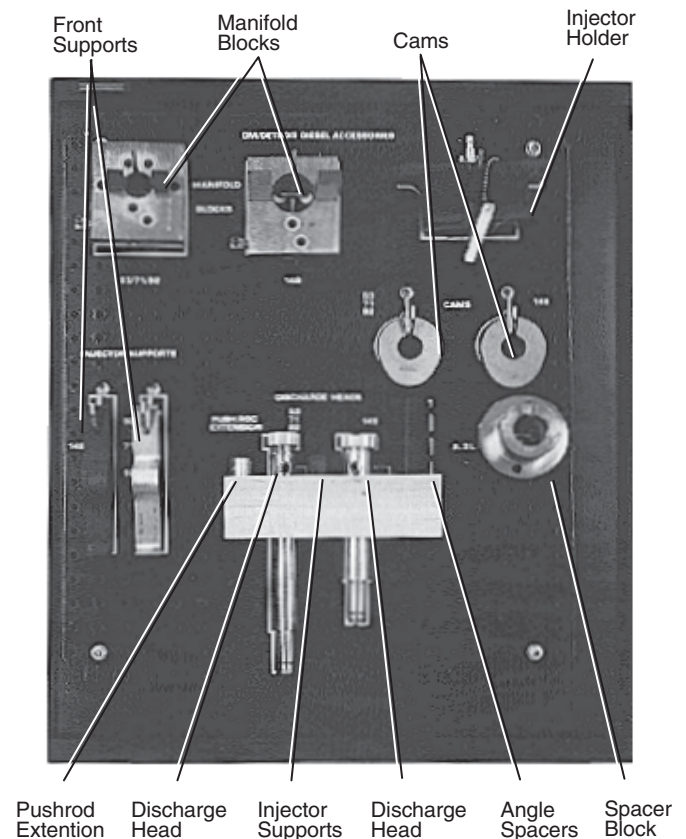


Figure 3-32. DD Injector Accessories

Detroit Diesel Accessory Part Number or Identification

Injector	Manifold Block	Front Support	Holder Assembly	Injector Discharge Head	Cam	Push Rod Extension	Fuel Connector
53, 71, 92	77-0613	67-6606	—	67-5696	77-0610	—	—
92 Marine	77-0613	77-0913	—	67-5696	77-0610	77-0912	77-0866
149	67-7643	67-6605	—	67-5700	67-6372	67-5708	—
8.2 liter	—	—	67-8525*	67-5696	77-0610	—	—

(— means the accessory is not needed)

*8.2 liter Injector Holder Set consists of a Spacer Block (67-6851), two Angle Spacers (67-6850), Injector Holder (67-6854), with key, and Mounting Instructions (67-9388).

Figure 3-33. Detroit Diesel Injector Accessories Chart

3.2.2 Changing Speed

The CD3 calibrator is shipped with the drive belt disengaged. To change the speed setting to test DD injectors:

1. Open the flywheel (sheave) cover to expose the upper pulleys.

2. Open the hinged door on the left side of the calibrator to expose the lower pulleys.
3. Insert barring tool into roller link assembly.
4. Push down on the barring tool to raise the motor enough to shift the drive belt from one set of pulleys to the other.
5. For 2000 RPM setting required for running the DD injectors, move belt to the smaller diameter pulley on camshaft (top) and the matching pulley on the motor shaft (bottom).
6. Before lowering the motor, slide the motor block shim (marked CUM) from under the leveler, as it is not needed for DD injectors.
7. Lower the motor to its original position.

Next, check for proper cam installation (Sec. 3.2.3).

3.2.3 Changing Cams

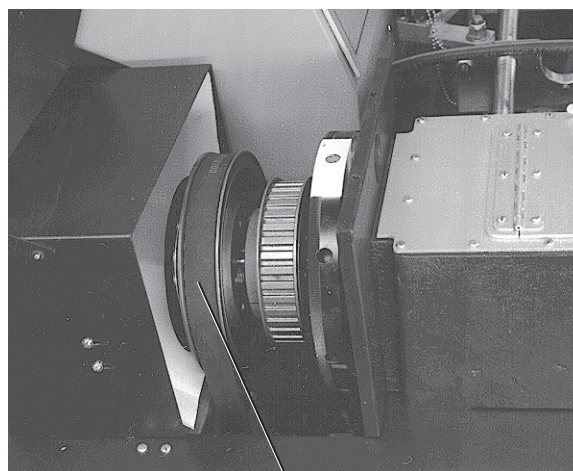
The cam is secured in place on the tapered end of the camshaft by a 3/4 in. hex nut and a 3/4 in. plain washer, and is locked to the shaft by a key.

When shipped from the factory, the calibrator has Cam 189 (67-6370) installed (used for most Cummins injectors). To change the cam:

1. Switch the power On/Off Switch to OFF.
2. Raise hinged lids of the cambox and flywheel.
3. Insert barring tool into one of the radial holes in the flywheel to hold camshaft in position.
4. Bar over flywheel until push rod is fully extended from cambox (cam at maximum lift).
5. Install push rod lock to hold the push rod when the cam is being removed.

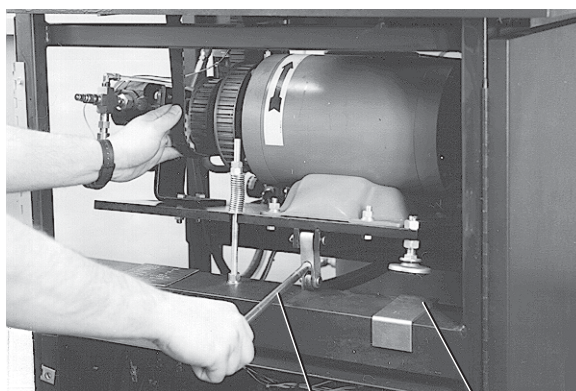
NOTE: Failure to do so can lead to disengagement of follower parts and subsequent early failure of cambox.

6. Using a 1-1/8 in. box wrench, unscrew and remove the nut, washer and cam.
7. Select proper cam for the injector to be tested:
Using Cummins service publications as a guide.



⑤ For Cummins Use Large Pulley

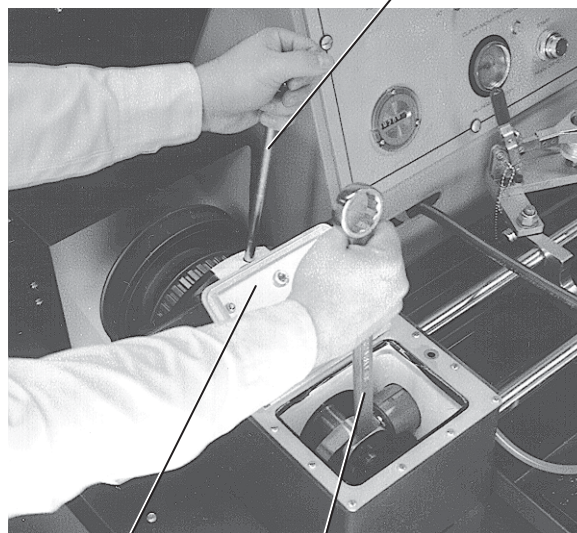
Figure 3-34. Pulley



③ Barring Tool (push down) ⑥ Shim

Figure 3-35. Changing Speed

③ Barring Tool



② Cambox Lid ⑥ Wrench

Figure 3-36. Changing Cams

<u>Injector</u>	<u>Cam P/N</u>	<u>Cam ID</u>
53, 71, 92 & 92 M	77-0610	53,71,92
149	67-6372	149
8.2L	77-0610	53,71,92

8. Fit the cam in place on the camshaft and make sure key in the cam is properly seated.

NOTE: *It is a good practice to check that the cam does not wobble on the camshaft. If wobble exists, dress the camshaft where required as applicable.*

9. Secure the cam with the washer and hex nut.
10. Remove pushrod lock.

The calibrator is now ready for mounting DD Injectors. Procedures for mounting DD injectors vary according to the style of the injector:

- Type 53, 71, 92 or 92 M Section 3.9
- Type 149 Section 3.10
- Type 8.2 liter Section 3.11

Follow the mounting procedure for the style injector you have.

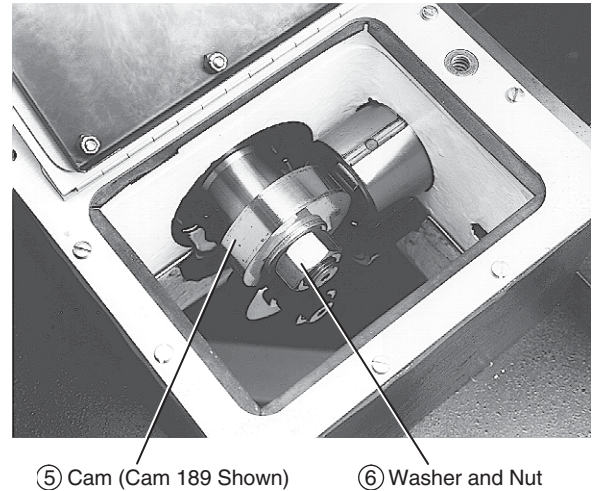


Figure 3-37. Cam & Hardware

3.2.4 Mounting DD Injector Types 53, 71, 92 and 92 Marine (92M)

Before mounting injectors, check cambox to be sure that cam 77-0610 (53, 71, 92, 92 Marine, or 8.2 L) is mounted on the camshaft.

The drain fitting for the manifold block assembly (77-0613) can be positioned in either of two return ports, depending on whether the injector to be tested is offset or standard. As supplied by Bacharach, the barbed elbow drain fitting is in position for offset injectors. For standard injectors, install the fitting in the other port.

The manifold block also includes three sets of standoffs: The long standoffs are for low crab injectors, the medium standoffs are for 92 Marine injectors, and the short standoffs are for high crab injectors.

3.2.4.1 Manifold

1. Slide the manifold block assembly (77-0613) over the dowel pins, with the inlet port face up. The return port with the barbed elbow should be on the far side in a horizontal position.
2. Install correct standoffs in the manifold block.

Long standoffs:	Low crab injectors
Medium standoffs:	92 Marine injectors
Short standoffs:	High crab injectors

3.2.4.2 Discharge Head

3. Insert the discharge head for 53, 71, 92, & 92M injectors (67-5696) into the clamp cylinder socket with the quick connect socket set for easy hose connection.

NOTE: When discharge heads are installed for the first time, wet O-ring with calibration fluid for easier installation.

4. Insert the flowmeter tubing with the quick connect plug into the discharge head socket.

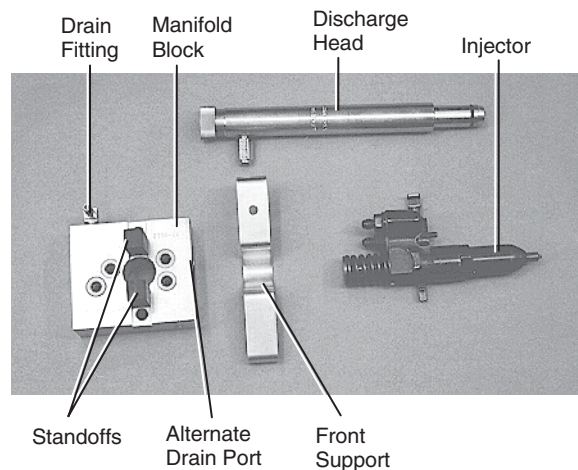


Figure 38. DD Type 53, 71, 92 & 92M Accessories

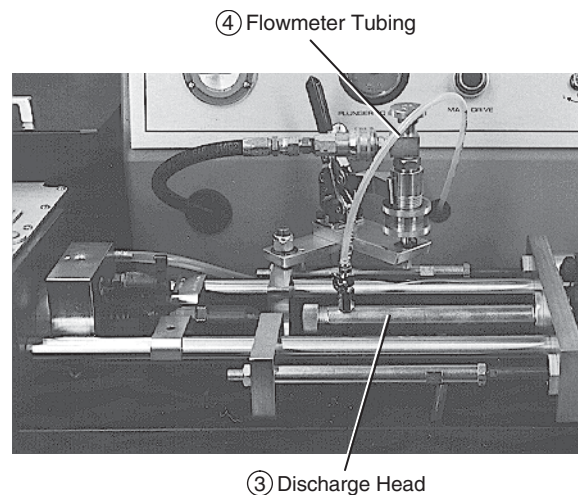


Figure 3-39. Accessory Setup

3.2.4.3 Body to Seat Clamp

NOTE: *The body-to-seat air clamping is not needed for DD injectors. To keep them out of the way, activate the air cylinders and leave them in clamped position during the test.*

5. Lift the pulley cover to expose the camshaft pulleys and flywheel.
6. Rotate flywheel by hand (barring tool inserted in holes in the flywheel can help in turning the flywheel) until the white painted area on the flywheel shows through the window.
7. Close the pulley cover. Cover must be closed for the main drive motor to operate.
8. To clamp the injector, press and hold down the HOLD TO OPERATE button
9. Press the BODY TO SEAT CLAMP button.

The air cylinders will retract and clamp injector.

10. Release the BODY TO SEAT CLAMP button when the BODY TO SEAT monitor turns green.

3.2.4.4 Tubing

11. Push one end of the two-foot plastic tubing over the fill tube (67-5292) and the other end over the barbed elbow at the OUTLET port on the manifold.

The plastic tubing and fill tube are part of the calibrator accessories.

12. Insert fill tube into the drain tray center hole.

3.2.4.5 Injector

13. Slip the front support (67-6606) over the rails approximately midway between the manifold block and the injector carrier plate.
14. Place the injector in position so the lower body rests on top of the semicircular front support and the fuel connectors are aligned with their ports in the manifold block.

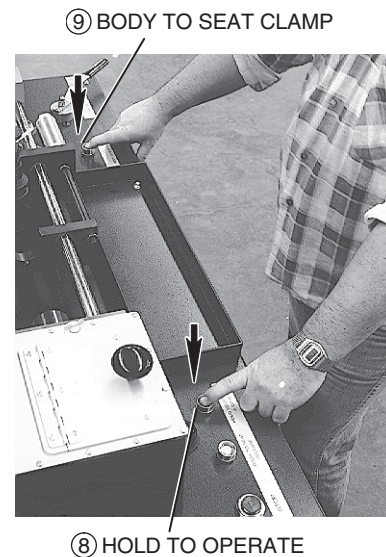


Figure 3-40. Body to Seat Clamp

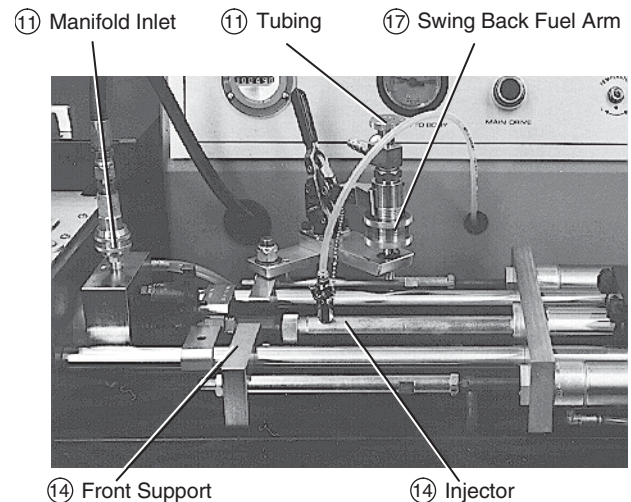


Figure 3-41. Injector Setup

15. Make sure the O-rings are in position in the manifold block connectors.

3.2.4.6 Fuel Inlet

16. Disconnect the fuel inlet hose from the fuel arm at the quick disconnect.
17. Swing the fuel inlet arm back toward console.
18. Connect hose to the fuel inlet connector at the manifold INLET.

3.2.4.7 Injector Clamping

19. Push and hold the HOLD TO OPERATE button with left hand.
20. While holding down the HOLD TO OPERATE button, move the CLAMP/UNCLAMP lever to the CLAMP position with right hand.

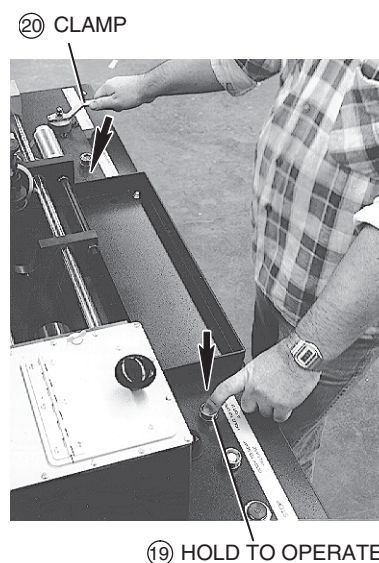


Figure 3-42. Injector Clamping

The maximum clamping force shown on CLAMP MONITOR/TIMING PLUNGER TO BODY gauge will be in the green segment of the dial and the PLUNGER TO BODY timing light will be lit.

21. Wait until the PLUNGER TO BODY timing light goes out (after about 3 seconds).
22. Release the HOLD TO OPERATE button **first** and **then** the CLAMP/UNCLAMP lever. The lever will return to the center position.

For clamping to occur correctly, you must follow this sequence carefully.

The gauge reading will decrease from the green segment of the dial to a lower reading (red segment) immediately after the CLAMP/UNCLAMP valve lever is returned to the center position.

The injector is now ready for testing (Section 3.2.7).

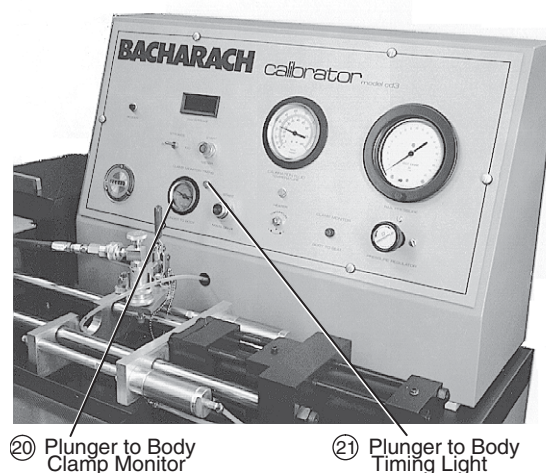


Figure 3-43. Timing Light & Clamp Monitor

3.2.5 Mounting DD Injector Type 149

Before mounting injectors, check cambox to be sure that cam 67-6372 (149) is mounted on the camshaft.

3.2.5.1 Manifold

1. Place push rod extension (67-5708) over the push rod.
2. Mount manifold block (67-7643) over dowels.
3. Attach the drain hose to the return fitting on the manifold.
4. Lay the front injector support (67- 6605) over the rails.

3.2.5.2 Discharge Head

5. Insert the discharge head (67-5700) into the clamp cylinder socket with the quick connect socket set for easy hose connection.

NOTE: When discharge heads are installed for the first time, wet O-ring with calibration fluid for easier installation.

6. Insert the flowmeter tubing with the quick connect plug into the discharge head.

3.2.5.3 Body to Seat Clamp

NOTE: The body-to-seat air clamping is not needed for DD injectors. To keep them out of the way, activate the air cylinders and leave them in clamped position during testing.

7. Lift the pulley cover to expose the camshaft pulleys and flywheel.
8. Rotate flywheel by hand (barring tool inserted in holes in the flywheel can help in turning the flywheel) until the white painted area on the flywheel shows through the window.
9. Close the pulley cover. Cover must be closed for the main drive motor to operate.
10. To clamp the injector, press and hold down the HOLD TO OPERATE button

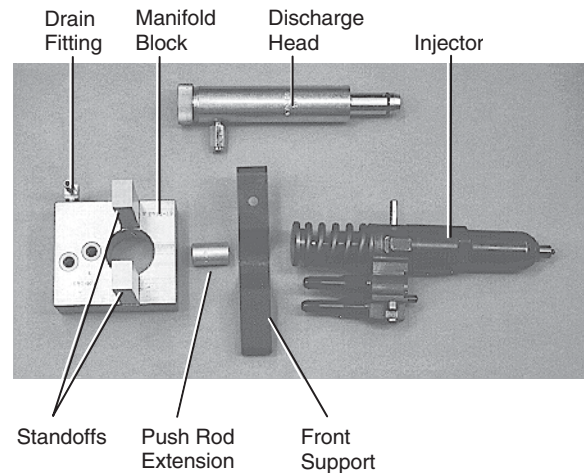


Figure 3-44. DD Type 149 Injector Accessories

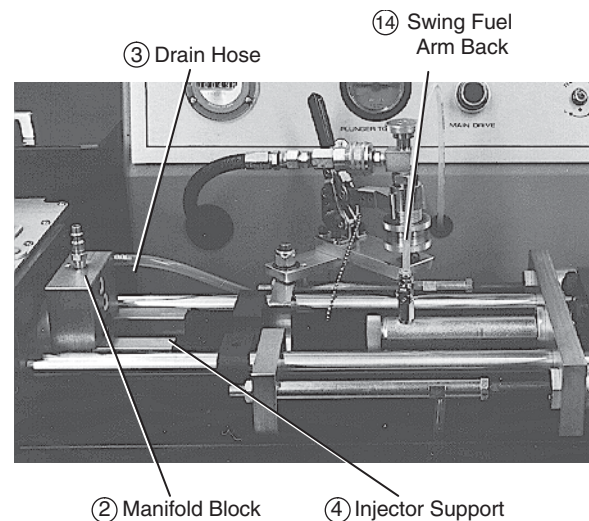


Figure 3-45. Accessory Setup

⑪ BODY TO SEAT CLAMP

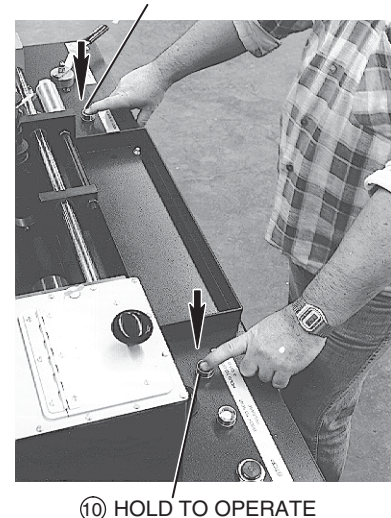


Figure 3-46. Body to Seat Clamp

The air cylinders will retract and clamp injector.

11. Press the BODY TO SEAT CLAMP button.
12. Release BODY TO SEAT CLAMP button when the BODY TO SEAT monitor turns green.

3.2.5.4 Fuel Inlet

13. Disconnect the fuel inlet tubing from the fuel arm by unscrewing the knurled knob.
14. Swing the fuel arm back toward console.
15. Connect fuel inlet fitting to manifold INLET.

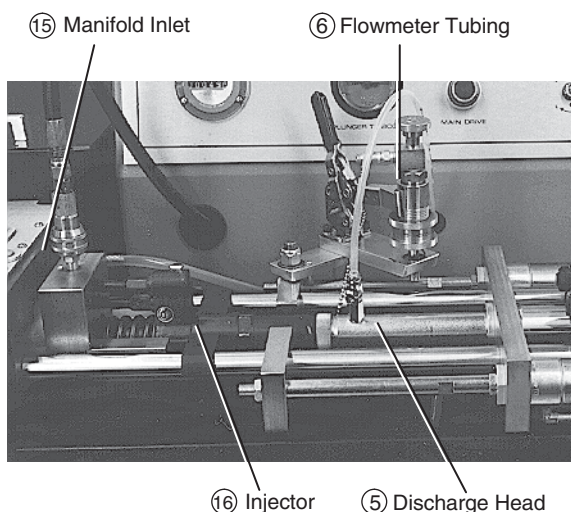


Figure 3-47. Injector Setup

3.2.5.5 Injector

16. Lay the injector into the support.
17. Guide the spring and plunger of the injector into the manifold block.

3.2.5.6 Injector Clamping

18. Push and hold the HOLD TO OPERATE button with left hand.
19. While holding down the HOLD TO OPERATE button, move the CLAMP/UNCLAMP lever to the CLAMP position with right hand.

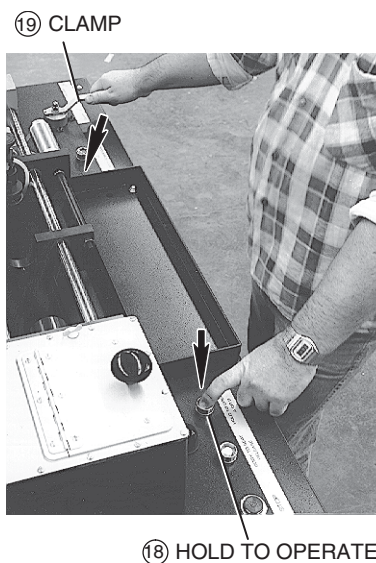


Figure 3-48. Injector Clamping

Maximum clamping force shown on the CLAMP MONITOR/TIMING PLUNGER TO BODY gauge will be in the green segment of the dial and the PLUNGER TO BODY timing light will be lit.

20. Wait until the PLUNGER TO BODY timing light goes out (after about 3 seconds).
21. Release the HOLD TO OPERATE button **first** and **then** the CLAMP/UNCLAMP lever. The lever will return to the center position.

For clamping to occur correctly, you must follow this sequence carefully.

The gauge reading will decrease from the green segment of the dial to a lower reading (red segment) immediately after the CLAMP/UNCLAMP valve lever is returned to the center position.

The injector is now ready for testing (Section 3.2.7).

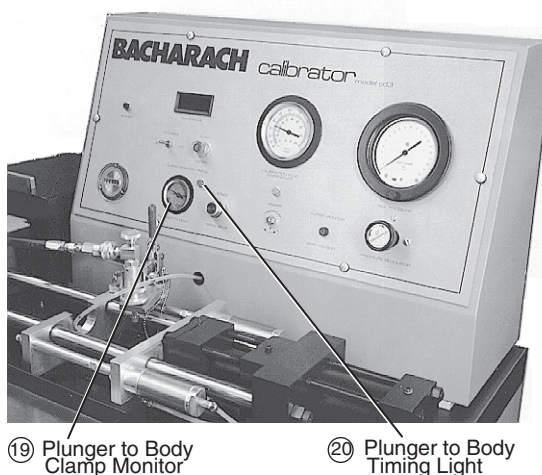


Figure 3-49. Timing Light & Clamp Monitor

3.2.6 Mounting DD Injector Type 8.2 Liter

Before mounting injectors, check cambox to be sure that cam 77-0610 (53, 71, 92, 92 Marine or 8.2 L) is mounted on the camshaft.

You will need injector holder assembly 67-8525 which includes the adapter, two angle spacers, a spacer block, and an injector holder with key.

3.2.6.1 Spacer Block

1. Attach the spacer block to the cambox over the two dowel pins on the push rod guide.

NOTE: Make sure the spacer block is flush against the push rod guide.

3.2.6.2 Discharge Head

2. Install the discharge head (67-5696) into the clamp cylinder socket with the quick connect socket set for easy hose connection.

NOTE: When discharge heads are installed for the first time, wet O-ring with calibration fluid for easier installation.

3. Insert the flowmeter tube with the quick connect plug into the discharge head.

3.2.6.3 Body to Seat Clamp

NOTE: The body-to-seat air clamping is not needed for 8.2 Liter injectors. To keep them out of the way, activate the air cylinders and leave them in clamped position during testing.

4. Lift the pulley cover to expose the camshaft pulleys and flywheel.
5. Rotate flywheel by hand (the barring tool inserted in holes in flywheel can help in turning the flywheel) until the white painted area on the flywheel shows through the window.
6. Close the pulley cover. Cover must be closed for the main drive motor to operate.
7. To clamp the injector, press and hold down the HOLD TO OPERATE button

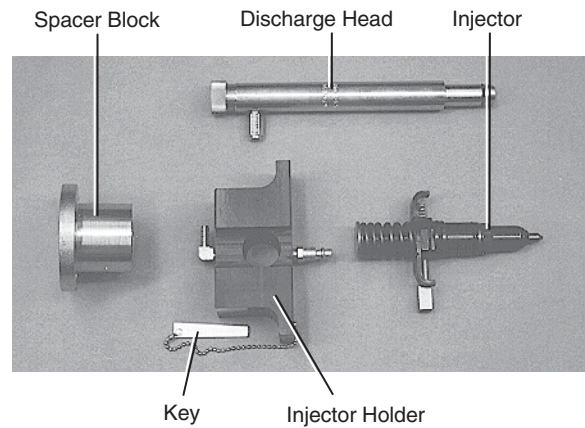


Figure 3-50. DD Type 8.2 Liter Injector Accessories

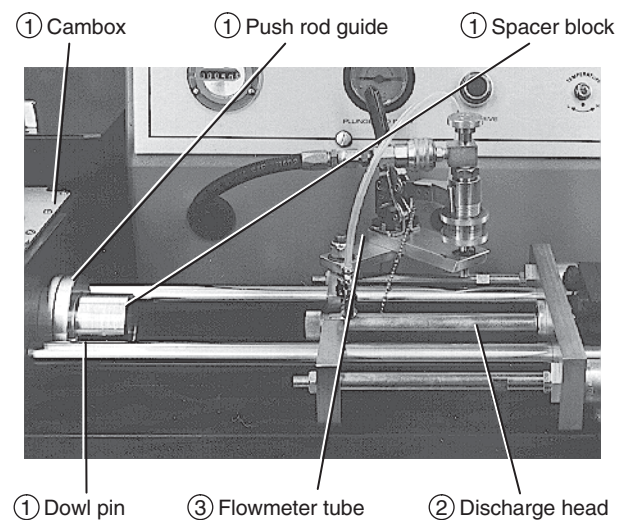


Figure 3-51. Accessory Setup

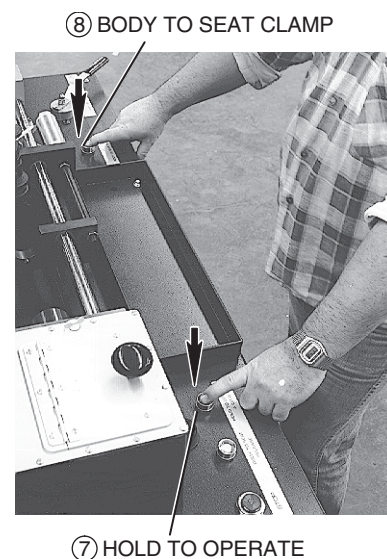


Figure 3-52. Body to Seat Clamp

8. Press the BODY TO SEAT CLAMP button.

The air cylinders will retract and clamp injector.

3.2.6.4 Injector

10. Install the injector into the injector holder by hand pushing until the mounting slots on both the injector and the holder are aligned.
11. Then secure with the key, straight edge towards the injector.

This will prevent the injector from moving out during testing.

12. Place the injector holder with the injector over the carriage rails.

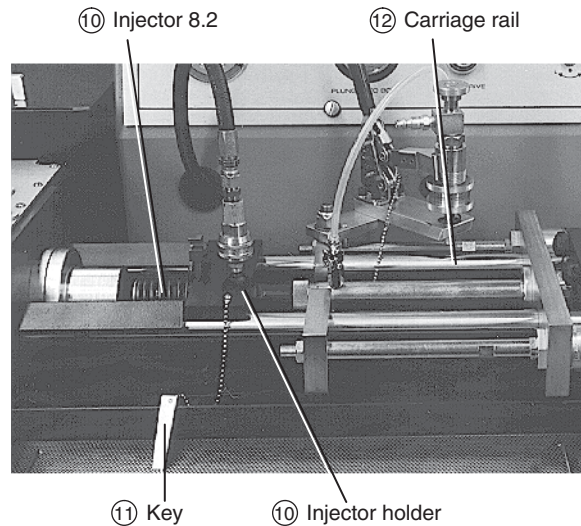


Figure 3-53. Injector Setup

3.2.6.5 Fuel Inlet

13. Disconnect inlet hose from quick disconnect at the fuel inlet arm and push into the quick connect at the top of the injector holder.
14. Attach the flexible plastic tubing to the barbed elbow at the bottom of the injector holder.
15. Insert the other end of the tubing into the hole of the drain pan.

3.2.6.6 Injector Clamping

16. Push and hold the HOLD TO OPERATE button with left hand.
17. While holding down the HOLD TO OPERATE button, move the CLAMP/UNCLAMP lever to the CLAMP position with right hand.

Maximum clamping force shown on the CLAMP MONITOR/TIMING PLUNGER TO BODY gauge will be in the green segment of the dial and the PLUNGER TO BODY timing light will be lit.

18. Wait until the PLUNGER TO BODY timing light goes out (after about 3 seconds).
19. Release the HOLD TO OPERATE button **first** and **then** the CLAMP/UNCLAMP lever. The lever will return to the center position.

For clamping to occur correctly, you must follow this sequence carefully.

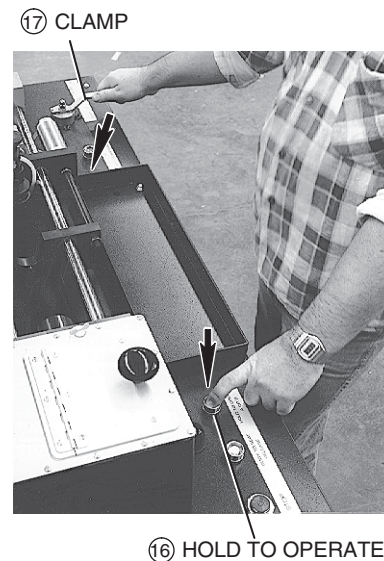


Figure 3-54. Injector Clamping

The gauge reading will decrease from the green segment of the dial to a lower reading (red segment) immediately after the CLAMP/UNCLAMP valve lever is returned to the center position.

The injector is now ready for testing (Section 3.2.7).

3.2.7 Testing

WARNING:

HAZARDOUS ROTATING MACHINERY. Do not open cambox cover while main drive motor is running.

NOTE: When starting main drive for the first time, run it for only a few seconds after pressure develops to make sure that all fuel connections are tight.

Make sure you have satisfactorily completed the Pre-Operation Checklist in Section 2.6 before trying to test any injectors.

Before testing Detroit Diesel Corporation injectors please read the following:

IMPORTANT NOTE:

It was recognized that testing unit injectors (manufactured by Diesel Technology Corporation for Detroit Diesel Corporation (DDC) engines) the results can be different from those obtained on other makes and models of calibrators.

In particular, it has been determined that Master Injectors marketed by Kent Moore all read higher on the Bacharach CD3 Calibrator by the amount shown below. Therefore, when checking Master Injectors, the fuel output as read on the digital readout of the CD3 Calibrator will be higher than the stamped values by the amounts shown:

Injector Type	Difference In Reading (mm ³ /str)
53	2.0
71	2.5
92	4.6
8.2L	2.3
149	3.9

The recheck limits (as given by DDC) of Master Injectors on any calibrator are $\pm 2\%$ of stamped value. As an example, for the type 71 Master Injector:

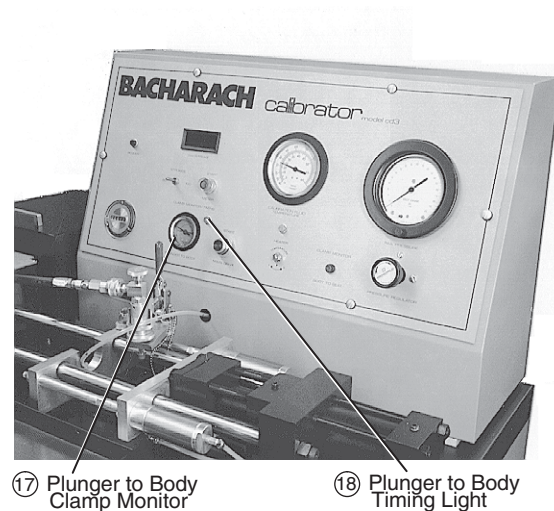


Figure 3-55. Timing Light & Clamp Monitor

Stamped Value	Add	Correct Value	Tolerance (2%)
72.0	+ 2.5 =	74.5	73.0 - 76.0

Therefore, for a type 71 Master injector stamped as 72.0, correct delivery value (fuel output) should be 73.0-76.0 mm³/str on a Bacharach CD3 Calibrator.

From the above it follows that when calibrating and/or checking injectors in service it is necessary to add the above numbers to the limits given by the manufacturer. For example:

Injector N75 (part No. 522877) has limits for the KM Calibrator of 75 - 80 mm³/str. On the CD3 it is necessary to add 2.5. Therefore, the new limits are 77.5 - 82.5 mm³/str.

1. Press the START MAIN DRIVE button.

NOTE: If main drive motor won't start, check the pulley cover. It must be tightly closed for the interlock safety switch to allow the main drive motor to operate.

2. Wait until trapped air escapes from the discharge head through the plastic tubing leading to the meter. Rapid chattering indicates that air is trapped in the tubing.
3. Check the fuel pressure on the RAIL PRESSURE gauge. It should be about 35 psi.
4. Set the STROKE selector on 100.
5. Press START METER on the console. The light in the button will come on.

The MM³/STROKE delivery display will show cumulative readings until 100 strokes are completed. At that time the reading will stay on until the next update which is after 100 strokes when the red dot will flash. Readings will be updated automatically every 100 strokes.

6. Observe the LED display and record fuel output readings.

The reading is in mm³/stroke, which is equivalent to cm³/1000 strokes (cc/1000 strokes). During a test run, if a change over is made from 50 to 100 stroke setting, or vice versa, ignore the next reading

7. When the test is over, press the STOP button on the left hand operator's table.

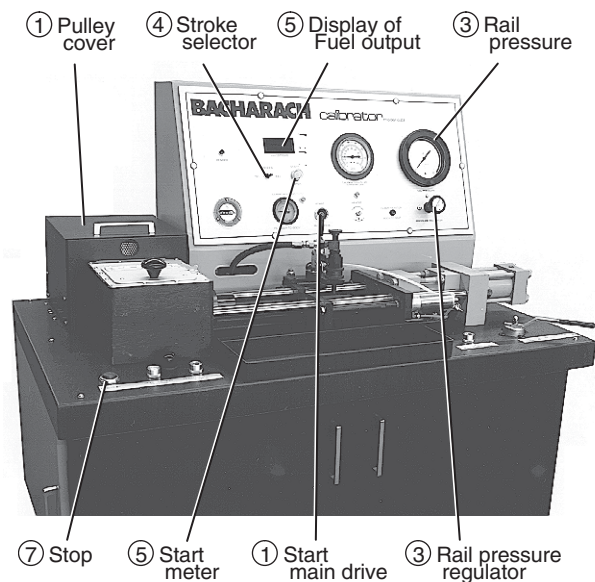


Figure 3-56. Testing Injectors

3.2.8 Unclamping

1. Disconnect the fuel inlet.
2. Press & hold the HOLD TO OPERATE button.
3. While holding button down, move the CLAMP/UNCLAMP lever to UNCLAMP position and let the hydraulic cylinder completely retract.
4. Release the HOLD TO OPERATE push-button and allow the CLAMP/UNCLAMP lever to return to its center position.

DD Type 8.2 Liters injectors

- a. Lift the key from the injector holder slot.
- b. Place the two angle spacers from the injector holder assembly (67-8525) over the rails between the cambox and injector.
- c. Press & hold HOLD TO OPERATE button. Gradually move the CLAMP/UNCLAMP lever to CLAMP position to extend clamping cylinder until the injector holder butts against the angle spacers next to cambox. Injector will "pop" out of injector holder.
- d. Repeat steps 3 & 4 again.

3.2.9 Removing Injectors & Shutting Down

1. Disconnect the fuel inlet hose from the injector holder or manifold.
2. Remove injector & accessories from calibrator.
3. Return accessories on inside cabinet door.
4. Disconnect flowmeter tubing from discharge head.
5. Remove discharge head & store inside cabinet.
6. Remove cam and store inside the cabinet door.

NOTE: Discharge head and cam can be left installed on the calibrator if desired.

7. Turn off power at On/Off Switch at lower left side of calibrator.
8. Wipe oil spills and splashes from console and operator's table.



Figure 3-57. Unclamping Injectors

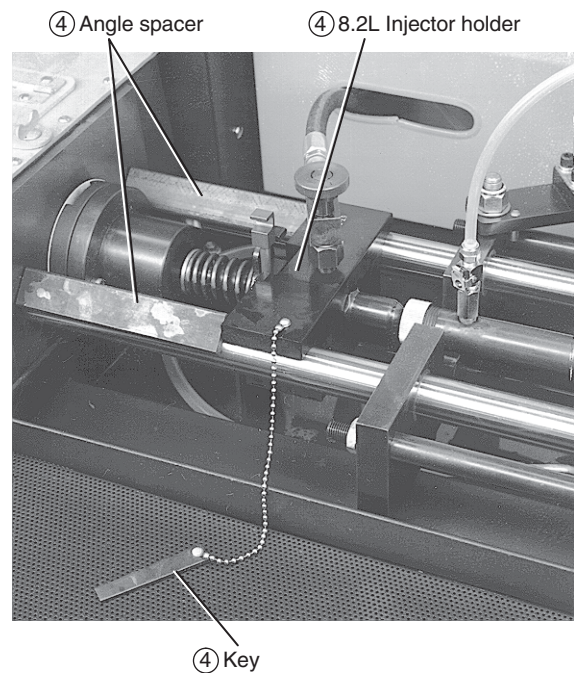


Figure 3-58. Unclamping DD 8.2L Injectors

NOTES

4.0 MAINTENANCE & TROUBLESHOOTING

4.1 Maintenance

4.1.1 Schedule

CHECK DAILY:

1. If calibration fluid is low, add enough fluid to bring the level up to the "F" on the dipstick. Use Bacharach part number 67-5598 (SAE J967).
2. If cambox oil is lower than 3-3/4 inch from the top of the cambox, add enough SAE 30W motor oil to bring the level up.

CHANGE OR CLEAN EVERY THREE MONTHS (or after 120 operating hours, whichever occurs first):

1. Calibration fluid
2. Filters
3. Flowmeter transducer strainer
4. Cambox oil

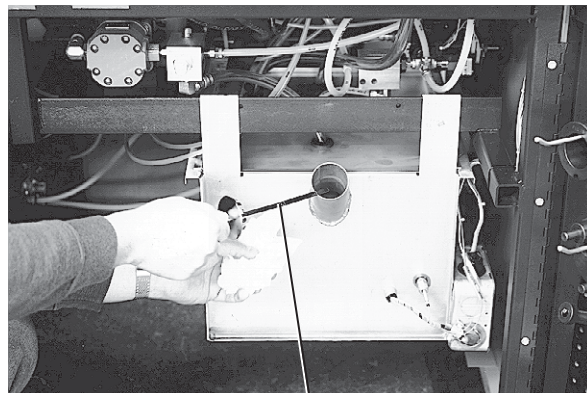
This schedule is only a guideline; maintenance will depend a great deal on the working environment and the cleanliness of the injectors.

See the following sections for these procedures.

4.1.2 Changing Calibration Fluid and Filters

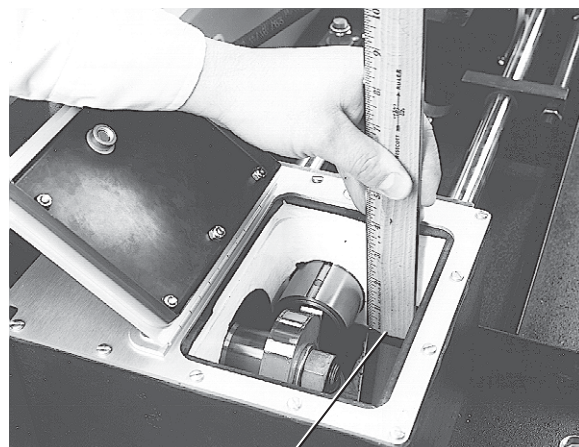
Calibration fluid change periods will depend greatly on the type of service. Inspect fluid periodically for contaminants and viscosity. Fluid must be changed when viscosity is above 3.1 centistokes (cst) at 100°F (38°C).

NOTE: To check viscosity use Viscor Cup Bacharach P/N (77-0391), part of the CD3 Audit Kit (67-7707).



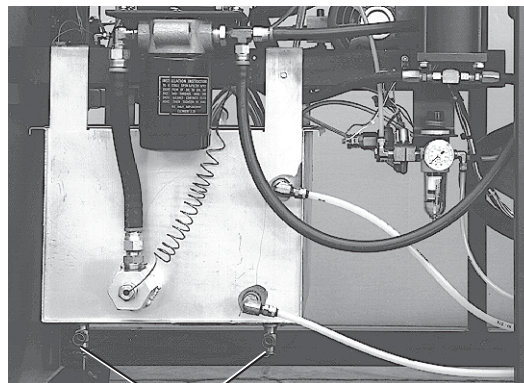
① Check calibration fluid level

Figure 4-1. Calibration Fluid



② Check cambox oil level

Figure 4-2. Cambox Oil



② Reservoir drains

Figure 4-3. Reservoir Drains

At the same time the fluid is changed, change the suction and final stage filters.

1. Remove the back panels of the calibrator.
2. Drain the old fluid using the drain valves, one on each side of the reservoir.
3. Lift the lid of the reservoir and inspect its bottom. Wipe clean if necessary.
4. Close both drains of the reservoir.
5. Through the dipstick port, fill the reservoir to the "F" mark on the dipstick with new fluid. Use Bacharach part number 67-5598 (SAE J967).

NOTE: *It's a good idea to fasten a tag to the reservoir giving the date the fluid was changed.*

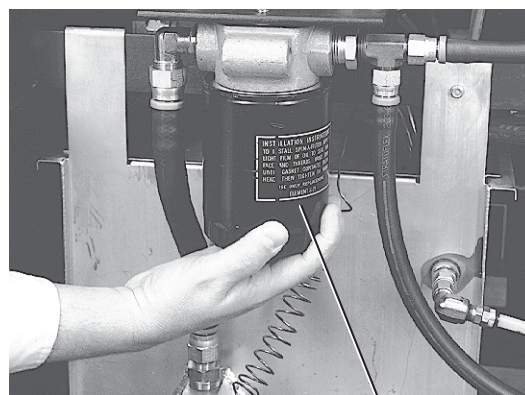
6. Unscrew the suction filter cartridge from its bracket and throw it away.
7. Replace the filter cartridge with a new one.
8. Using a wrench, remove the bolt from the top of the final stage filter.
9. Remove the old filter and install a new one.

NOTE: *Before installation fill the can with new calibration fluid.*

10. Reinstall the filter can.
11. Bleed excess air from the filter after starting the calibrator.

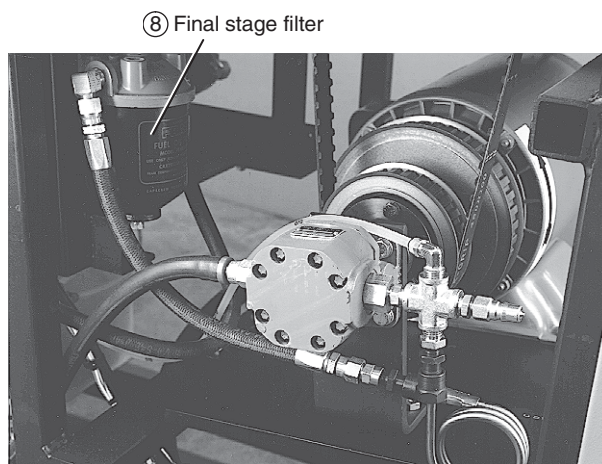
NOTE: *Fasten tags on both filters giving the date they were changed.*

12. Remove and clean flowmeter strainer.



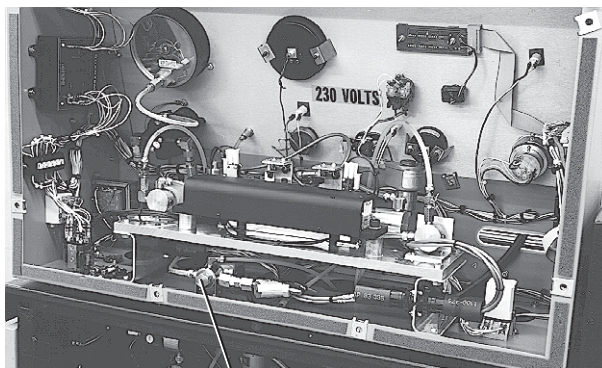
⑥ Suction filter

Figure 4-4. Suction Filter



⑧ Final stage filter

Figure 4-5. Final Stage Filter



⑫ Flowmeter strainer

Figure 4-6. Flowmeter Strainer

4.1.3 Changing Cambox Oil

After three months or 120 hours of operation (see hour meter), whichever occurs first, (or if the oil becomes contaminated) drain the oil from the cambox and refill using the following procedure:

1. Open drain plug on bottom of cambox and allow old oil to drain out. Drain plug is accessible after left-hand cabinet door is open.
2. Reinstall drain plug.
3. Fill the cambox with enough SAE 30W motor oil to bring the level up to within 3-3/4 inch from the top (or 1-1/2 inch from the bottom).

Do not fill above the 3-3/4 inch level.

4.1.4 Cleaning and Lubricating

The CD3 calibrator will remain in good working condition with just ordinary cleaning procedures. It is important, however, to avoid spilling or dropping contaminants into the drain tray where they can mix with the calibration fluid. For the same reason, injectors should be cleaned before being tested.

The calibrator's mechanical parts are largely self-lubricating and therefore no special lubricating procedures are required. The two electric motors are sealed and lubricated for life.

4.1.5 Checking Flowmeter Cavity

The flowmeter fluid level should be checked and refilled according to the directions in Section 2.6 after the first 60 and 120 hours of operation. It should be rechecked every 120 hours of operation, or sooner if deemed necessary.

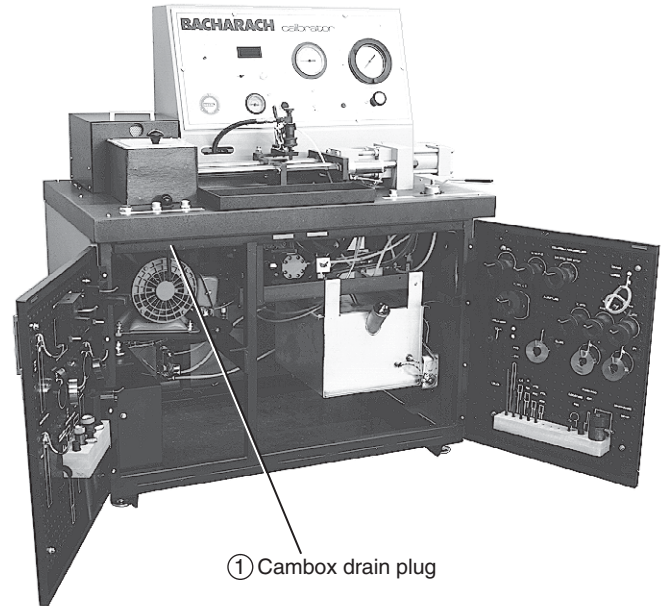


Figure 4-7. Cambox Drain Plug

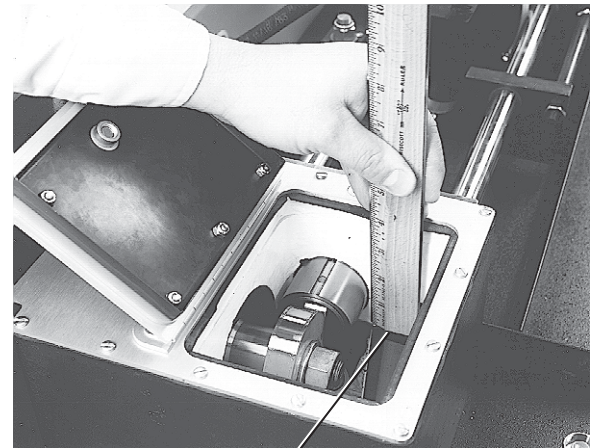


Figure 4-8. Cambox oil Level

4.2 TROUBLESHOOTING

4.2.1 Charts

TROUBLESHOOTING CHART FOR MECHANICAL PROBLEM

Fault	Possible Cause and Remedy
Plunger-to-body clamp faulty	<p>May lack unlocking pressure — Press HOLD TO OPERATE button and listen for valve reliefs (“putt” sound).</p> <ol style="list-style-type: none"> If after three putts, cylinder will still not move, there may be insufficient hydraulic pressure. <ol style="list-style-type: none"> Check intensifier hydraulic circuit for leaks. Check hydraulic pressure at the cylinder (Section 8.2). If there are no putt sounds, check air pressure gage at secondary air pressure regulator and make sure that solenoid valve is operative.
Clamp force not repeating	<ol style="list-style-type: none"> Air may be in clamp system because of low oil level in the intensifier reservoir. <ol style="list-style-type: none"> Bleed air at bleed port (Section 8.2). Fill intensifier reservoir (Section 4). Make sure all fittings and hoses leading from the reservoir to the clamp pump are tight. Faulty clamp pressure regulator — replace
Pressure drops in injector supply circuit	Pressure regulator knob may have been moved — Check that setting is correct and locked (by tightening nut on stem).
Calibration fluid temperature too high	<ol style="list-style-type: none"> Cold water supply may be turned off — Turn on supply. Water flow through calibrator may be disrupted — Disconnect return line with heat lamp off at console and observe for presence of water flow. Temperature control system may not be operating properly — See Chapter 2 for proper operation.
Fuel arm leaks	May be faulty or missing “O” ring — Replace “O” ring (Section 8.3).

TROUBLESHOOTING CHART FOR ELECTRICAL PROBLEMS

Fault	Possible Cause and Remedy
Motor trips off	<ol style="list-style-type: none"> 1. Overload setting may be too low – Readjust (Section 4.3.5). 2. Improper line voltage – Verify that incoming line voltage meets specifications. 3. Excessive vibration may induce interlock switches to open intermittently – Check S4, S12, S3, M1 (aux), or M1OL. 4. Main motor may be defective – Replace or Repair. 5. Loss of line phase – Investigate and correct problem. 6. Motor overload – Troubleshoot and correct problem.
Main motor will not start	<ol style="list-style-type: none"> 1. Pulley cover may be open – Close cover. 2. Interlock (S3) may be out of line or defective – Reposition or Replace (Section 4.3.3). 3. Motor starter reset button may have tripped – Reset M1 button (Section 4.2.4). 4. Fuse F-1 (2Amp) may have blown – Replace (Section 4.2.5) and investigate cause. 5. Air supply may be blocked – Check shop air supply and connections. 6. “STOP” button may be defective – Repair or Replace.
Calibration fluid temp. unstable	<ol style="list-style-type: none"> 1. Fuse F-5 (5Amp) may be blown – Replace (Section 4.2.5) and investigate cause. 2. Temperature controller may be defective – Replace. 3. Potentiometer R1 may be defective – Replace. 4. Heaters (HTR1 or HTR2) may be defective – Replace. 5. Cooling water solenoid may be defective – Replace. 6. Calibration fluid in reservoir may be low – Increase fluid level. 7. Temperature Sensor may be defective – Replace. 8. Thermometer may be defective – Replace. 9. Cooling water supply may be absent – Connect and turn on water supply.
Body-to-seat clamp inoperative	<ol style="list-style-type: none"> 1. Fuse F-1 (2 Amp) may have blown – Replace (Section 4.2.5). 2. Relay K-2 (part no. 04-5298) may be defective – Replace. 3. Fuse F-2 (0.4 Amp) may have blown – Replace. 4. Optical detector (part no. 60-7000), located on cam drive shaft, may be improperly adjusted or defective – Readjust (Section 4.3.4) or Replace. 5. Air pressure may be low – Check shop air pressure (Section 4.3.2). 6. Main P.C. board (part no. 67-6910) may be defective – Replace**.
Flowmeter display inoperative	<ol style="list-style-type: none"> 1. Display P.C. board (part no. 67-5690) may be defective – Replace**. 2. Optical detector (part no. 60-7000), located on cam drive shaft, may be improperly adjusted or defective – Readjust (Section 4.3.4) or Replace. 3. Main P.C. board (part no. 67-6910) may be defective – Replace** 4. Relay K1 may be defective – Replace. 5. Bypass solenoid may be defective – Replace. 6. Transducer may be defective – Replace.
Erratic flow readings*	<ol style="list-style-type: none"> 1. Encoder wheel (part no. 67-6414) bent or slots in wheel obstructed – Replace or Clean as required (Section 4.3.4). 2. Loose or broken wiring or shields – Replace or Repair. 3. Discharge head defective – Repair or Replace 4. Leak in discharge line – Repair.
Flowmeter display indicates large flow value (beyond injector capability)*	<ol style="list-style-type: none"> 1. Main P.C. board (part no. 67-6910) may be defective – Replace**. 2. Optical Detector (part no. 60-7000) may be defective – Replace.

TROUBLESHOOTING CHART FOR ELECTRICAL PROBLEMS (cont.)

Fault	Possible Cause and Remedy
Flowmeter displays all zeros; will not display flow readings*	<ol style="list-style-type: none"> 1. Connector to main P.C. board may be loose – Reconnect. 2. Flowmeter limit switches may be tripped – Remove power and reposition piston adapter block to center of cavity. 3. Detector #1 on flowmeter transducer may be defective – Replace. 4. Solenoid L8 may be defective – Replace.

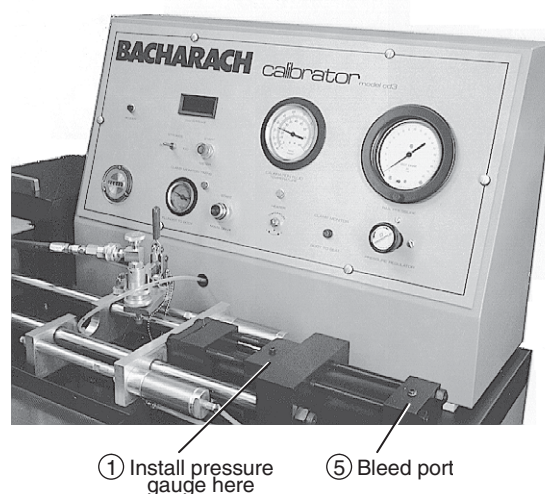
* If troubles with the flowmeter and main printed circuit board prove difficult to isolate, follow the isolation procedure listed in Section 4.2.6.

** When replacing a printed circuit board, replace both the main printed circuit board and the display board.

4.2.2 Hydraulic System**Checking Hydraulic Pressure**

To make sure that sufficient hydraulic pressure is applied to the hydraulic cylinder locking sleeve:

1. Install a 0 to 5000 psi gauge at the upper port of the hydraulic cylinder.
2. When holding the HOLD TO OPERATE button, check the pressure reading. Pressure must be 3700 - 4500 psi.
3. If pressure is less than 3700 psi, check for air and hydraulic leaks between the hydraulic pump and the cylinder. Make sure that the secondary air pressure supply is 60 - 65 PSI.
4. Remove the gauge installed in step 1.

**Bleeding Air from System**

4. Add oil to intensifier reservoir, if necessary, (see Section 4).

NOTE: Gauge port is the same as bleed port for locking circuit.

5. Use 3/16 inch hex to “crack” plug at gauge port.
6. Press and hold the “HOLD TO OPERATE” button and let some fluid flow past the loosened plug.
7. Allow air to escape through port until oil flows freely.
8. While oil flows, tighten plug. Release the button.
9. Replenish oil in the reservoir immediately after bleeding.

Figure 4-9. Checking Hydraulic Pressure

4.2.3 Replacing O-ring in Fuel Arm

If calibration fluid is leaking at the fuel arm:

1. Pull cotter pin.
2. Tilt back clamp arm.
3. Lift out fuel connector and turn over. (Do not lose spring and washer.)
4. Remove and replace O-ring.
5. Lower arm and reinstall the cotter pin.

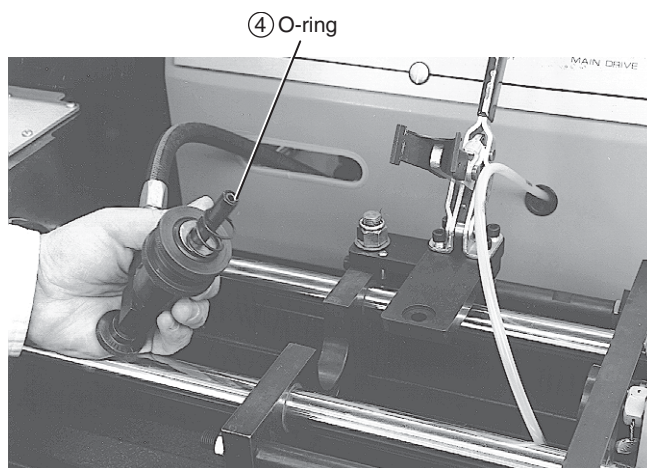


Figure 4-10. Fuel Arm O-Ring

4.2.4 Resetting Switches

Resetting the Motor Reset Button

In the event of a motor overload condition:

1. Remove the electrical box cover (lower left side panel).
2. Press the main motor reset button.
3. Investigate why the motor was overloaded.

Resetting Flowmeter Limit Switches

If the flowmeter displays all zeros or will not display flow readings, the limit switches may be tripped.

1. Disconnect power to the flowmeter by switching the On/Off Switch (left side panel) to OFF.
2. Remove console rear cover.
3. Reposition the flowmeter piston so that the adapter block is centered in the cavity.
4. Reconnect main power.
5. Restart the calibrator by switching ON the On/Off Switch on the left side panel of the calibrator.
6. If the flowmeter again displays all zeros check the optical detectors. They may have to be cleaned or replaced.
7. Restart the calibrator.
8. If the flowmeter still will not work, the main printed circuit board (PCB) may have to be replaced, see Section 4.2.6.

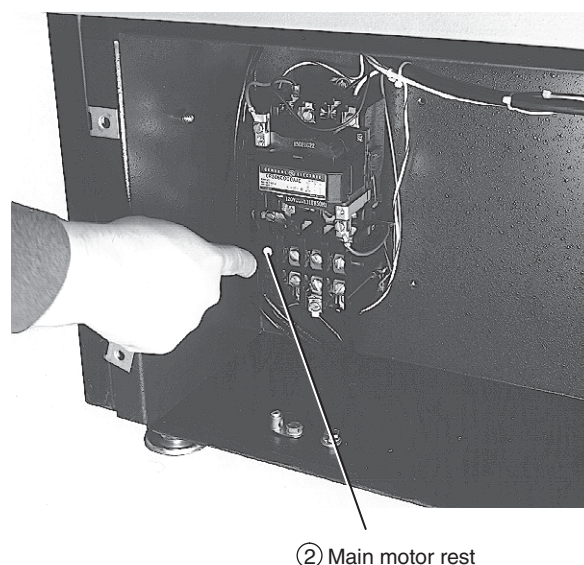


Figure 4-11. Main Motor Reset

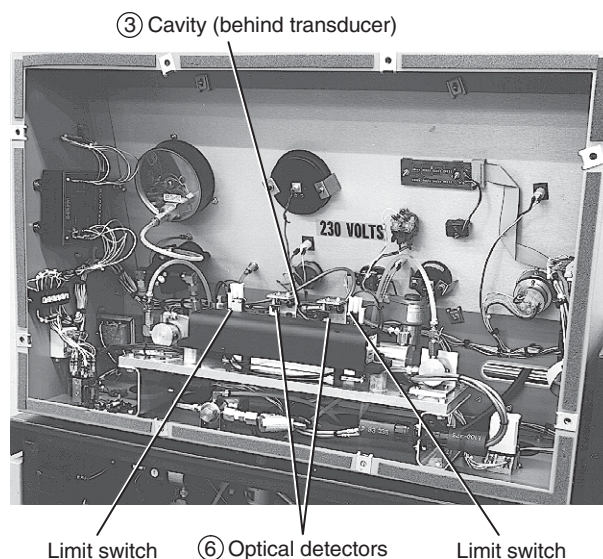


Figure 4-12. Flowmeter Limit Switches

4.2.5 Changing Fuses

F-1 (2 Amps): This fuse is in the main power circuit for all control circuits. If this fuse blows, the operator's console will indicate the following:

POWER Indicator (Red):	ON
HEATER Indicator (Amber):	ON or OFF
LED Display (Red Dot):	OFF
All Clamping Functions:	OFF
Main Drive Start:	OFF

F-2 (0.4 Amps): This fuse controls the flowmeter transducer circuit. If fuse blows, the operator's console will indicate the following:

POWER Indicator (Red):	ON
HEATER Indicator (Amber):	ON or OFF
LED Display (Red Dot):	OFF (blank)
"A" Body-to-Seat Clamp:	inoperative
Main Drive Start:	ON
Flowmeter Transducer piston:	inoperative

F-3/F-4 (4 Amps): Both fuses F-3 and F-4 are for special voltage options 380 and 460 VAC operation. These fuses control input to Transformer T-3. If either fuse blows, the operator console will indicate the following:

All power:	OFF
------------	-----

F-5 (5 Amps): This fuse controls the calibration heaters circuit. If this fuse blows, the following will be effected:

Heater power:	OFF
Cooling water supply circuit power:	OFF
HEATER lamp DS1 (Amber) on the operator's console:	OFF

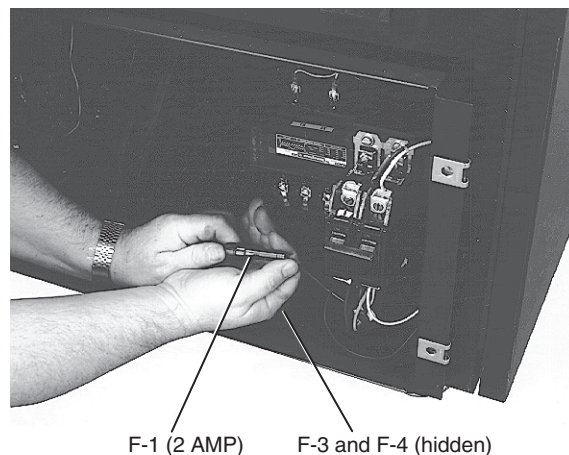


Figure 4-13. Fuses in Control Box

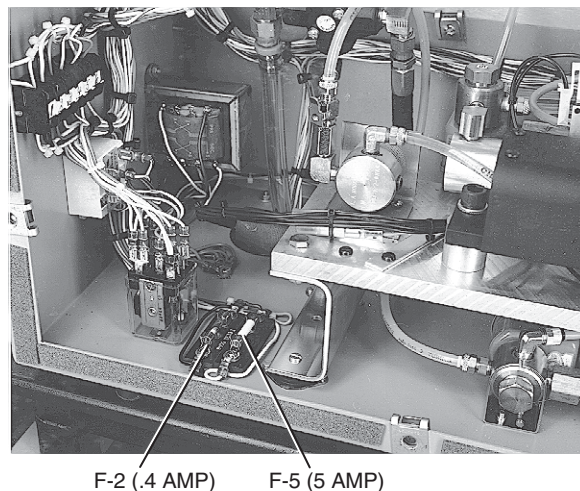


Figure 4-14. Fuses under Flowmeter

4.2.6 Checking Main PC Board

Between these terminals

on the main P.C. board: Voltage should be:

If not, probable cause is:

15 and 16	11 to 13 VAC	Defective fuse F-2 or transformer T2.
8 and 1	4.5 to 5 VDC	Defective main P.C. Board.
8 and 2	3 to 5 VDC	Defective optical detector #1.
8 and 2 (with detector blocked)	0 to 2 VDC	Defective optical detector #1.
8 and 3 (with cam top dead center)	3 to 5 VDC	Defective optical detector #2.
8 and 3 (with cam bottom dead center)	0 to 2 VDC	Defective optical detector #2.
8 and 5	0 VDC	
8 and 6	0 or 4.5 VDC*	Defective transducer.
8 and 7	0 or 4.5 VDC*	Defective transducer.
8 and 9	5.5 or 6.0 VDC	Defective main P.C. Board.
8 and 14 (with cam top dead center)	4.5 to 5 VDC	Defective main P.C. Board.
8 and 14 (with cam bottom dead center)	0 VDC	Defective main P.C. Board.
8 and 5	4.5 to 5 VDC	Defective K1 relay.

*Movement of the flow transducer encoder arm will cause voltage change.

ADDITIONAL VOLTAGE CHECKS

Terminals:	Voltage should be:	If not, probable cause is:
across K1 coil	115 VAC	Defective motor start switch or S6 M1 auxiliary contact.
L6 or L7 solenoid on	should be energized	Defective K3 (or when K3 is manually transducer operated, they should not be energized).

4.3 Adjustments

4.3.1 Calibration Fluid Temperature Adjustment

The CALIBRATION FLUID TEMPERATURE gauge was calibrated at the factory to indicate the fluid temperature about one inch upstream of the fuel arm. This calibration was performed at stabilized conditions using special fixtures and an electronic digital thermometer.

Do not change the temperature gauge calibration without use of a special fixture and procedure. Bacharach supplies the procedure and special fixture as part of the CD3 Calibrator Audit Kit (PN 67-7707)

4.3.2 Air Pressure Regulator Adjustment

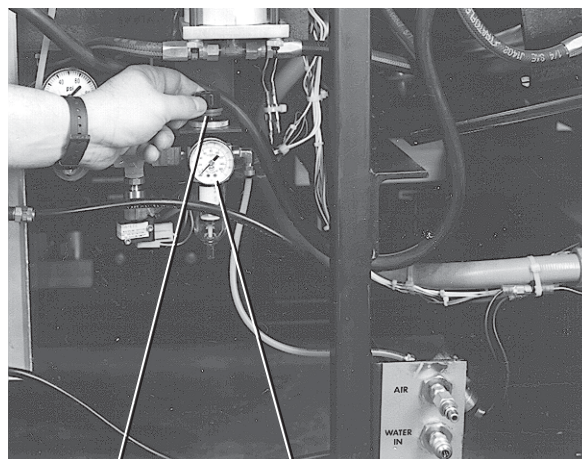
Required air pressure is set at the factory to produce the proper clamping force by the air cylinders and the correct pressure for unlocking the hydraulic cylinder. If for any reason it is necessary to change this setting:

1. The Primary Air Pressure Regulator should be set at 90 ± 5 psi, the Secondary Air Pressure Regulator must be set at $60 +5 -0$ psi (4.1 bar). The air pressure regulators are behind the lower rear panel (See Section 2.3).

CAUTION

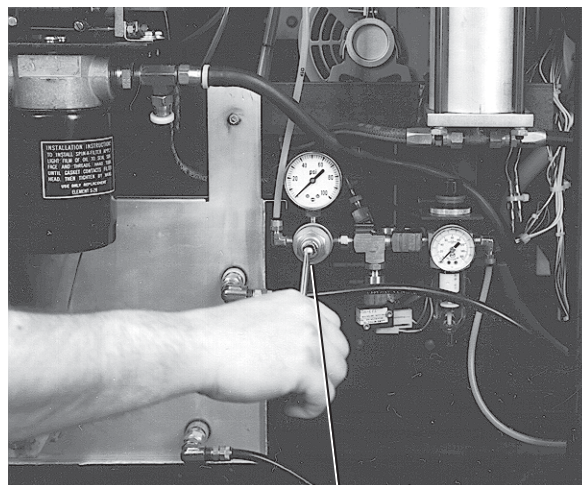
HIGH PRESSURE CAN DAMAGE AIR REGULATOR. Shop air supply must be less than 125 psi.

2. To adjust the Primary Air Pressure Regulator, lift the ring on top of the regulator.
3. Hold the ring up and turn it to adjust the incoming pressure to 90 psi.
4. Push the ring back down to lock the setting.
5. To adjust Secondary Air Pressure Regulator, loosen locknut and turn adjusting screw clockwise to increase and counterclockwise to decrease pressure. Adjust to $60 +5 -0$ psi.
6. Retighten the locknut.



② Red ring ② Primary air pressure regulator

Figure 4-15. Primary Air Pressure Regulator



⑤ Secondary air pressure regulator

Figure 4-16. Secondary Air Pressure Regulator

4.3.3 Adjusting Pulley cover Interlock

1. Adjust pulley cover up or down so that when closed, the cover will push in the button on the pulley cover interlock.
2. Adjust latch, if necessary, so that cover closes completely and stays closed while calibrator is operating.

4.3.4 Adjusting Optical Detector on Camshaft

The optical detector is mounted on a cross bar in the rear under the pulley cover. The encoder wheel is a thin disk which passes through a slot in the detector.

1. If the encoder wheel rubs the sides of the slot in the detector, loosen the nuts holding the detector to the cross bar.
2. Adjust the detector forward or back until the encoder wheel rides through the center of the slot.

4.3.5 Motor Starter Overload Relay Setting

1. Find the operating volts located on the nameplate of the test stand.
2. Locate the FLA (Full Load Amps) and SF (Service Factor) for the corresponding voltage (step 1), which can be found on the main drive motor.
3. The minimum dial setting on the Motor Starter Overload Relay is equal to the FLA value.
4. The maximum dial setting on the Motor Starter Overload Relay is calculated by multiplying the FLA value times the SF.
5. Set the A (Auto), H (Hand) switch to H (unlocked position).

4.3.6 Changing Drive Belt

To change the drive belt, it is necessary to disassemble some components. Proceed as follows:

1. Switch the On/Off Switch to the OFF position.
2. Open the pulley cover.

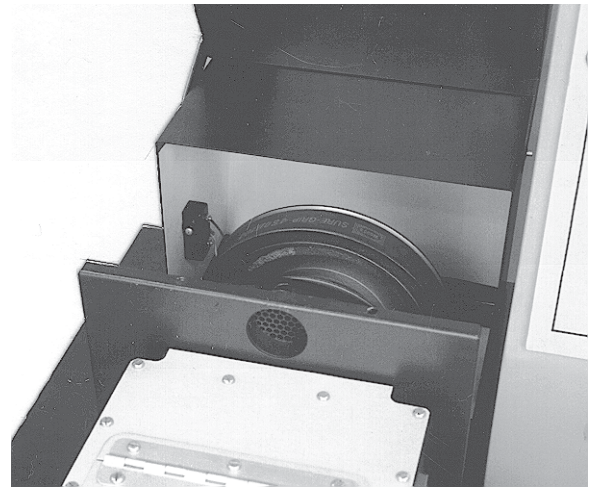


Figure 4-17. Pulley Cover Interlock

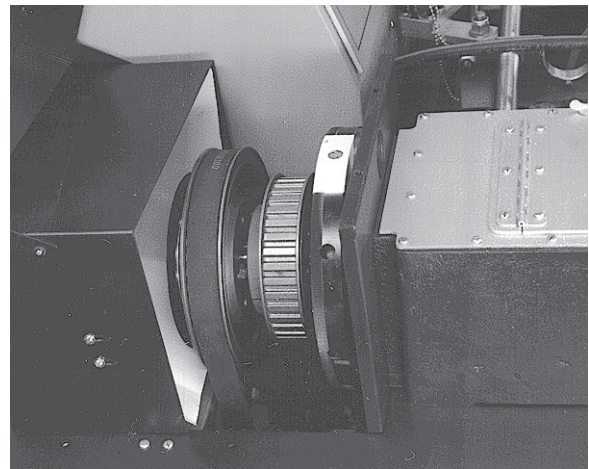


Figure 4-18. Optical Detector

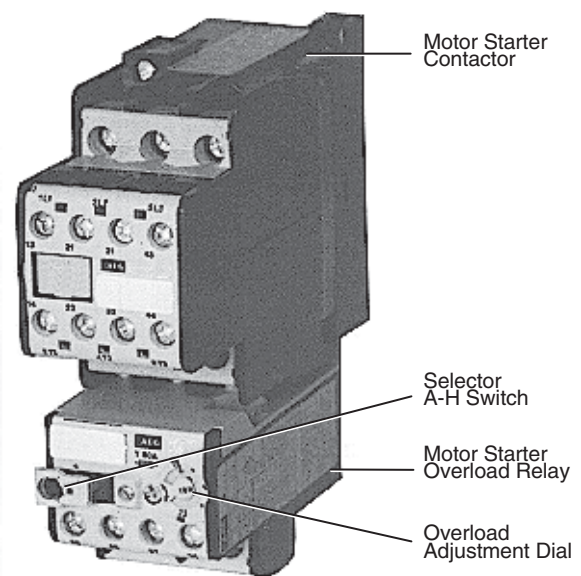


Figure 4-19. Motor Starter Overload Relay

3. Open the hinged side door.
4. Remove the upper back panel.
5. Loosen the nuts holding the optical detector to cross bar, and remove it from the cross bar.
6. Match mark the gear pump bracket and the motor mounting plate.
7. Remove two bolts which secure the gear pump bracket to the plate.
8. Slide the pump assembly off the end of the motor shaft.
9. Insert the barring tool into the roller link assembly and exert downward pressure raising the motor. Leave the motor in the raised position.
10. Slip the new belt through the openings thus provided and over the large diameter pulley on top and the small diameter pulley below.
11. Reassemble the optical detector on the cross bar, being careful to align it as per Section 4.3.4.
12. Reassemble the gear pump to the end of the motor shaft.
13. Lower the motor to its original position.
14. Adjust the motor mounting plate spring tension for 3-3/4 inches.
15. If required, slide the motor block shim (marked CUM) under the leveler.
16. Lower or raise the leveler by hand until it just contacts the shim.
17. Then lower the leveler one more turn and lock it with the lock nut.
18. Check that the belt is now snug but not too taut.
19. Close the pulley cover.
20. Switch on the On/Off Switch.

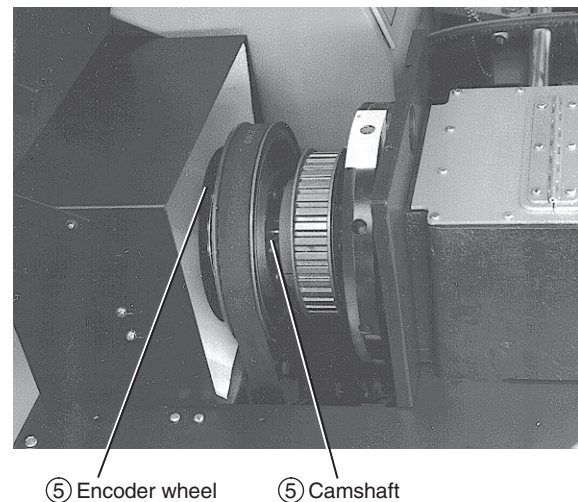


Figure 4-20. Drive Belt (Top)

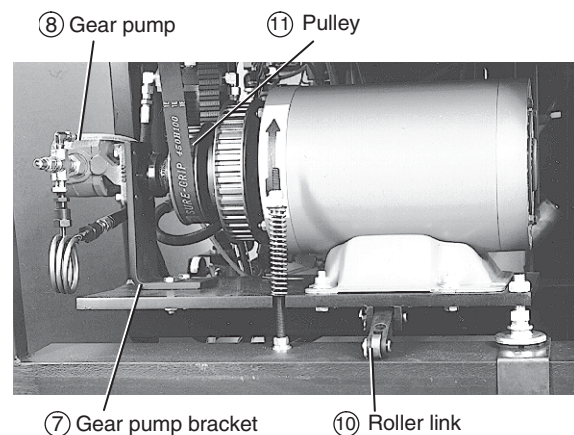


Figure 4-21. Drive Belt (Bottom)

CAUTION

Before turning on main drive, make sure that the injector supply hose (with quick connect) is either connected to the fuel arm or is disconnected. Any other connection (for instance - to a manifold block when no injector is installed) can cause fluid to squirt everywhere.

22. Run the calibrator to check that the belt is running smoothly.
23. After the first 50 hours of operation. Check the belt tension.
24. If necessary, readjust the belt tension (steps 14 to 18).

4.3.7 Replacing Push Rod Shear Pin

(applies to Cummins Injector testing)

To replace a broken shear pin (67-5702) in the push rod extension (67-5706):

1. Extract plug with a #10-32 screw, sleeve, washer and nut.
2. Push out old pin from plug and body.
3. Reinstall plug.
4. Align holes in plug with those in the push rod.
5. Press in a new shear pin (spares are supplied with accessories).

NOTES

5.0 ILLUSTRATED PARTS LIST

These lists include most parts which may need replacing under normal operating conditions. If other parts are needed, consult the Bacharach factory.

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5.13	Standard Calibrator Accessories	5-24
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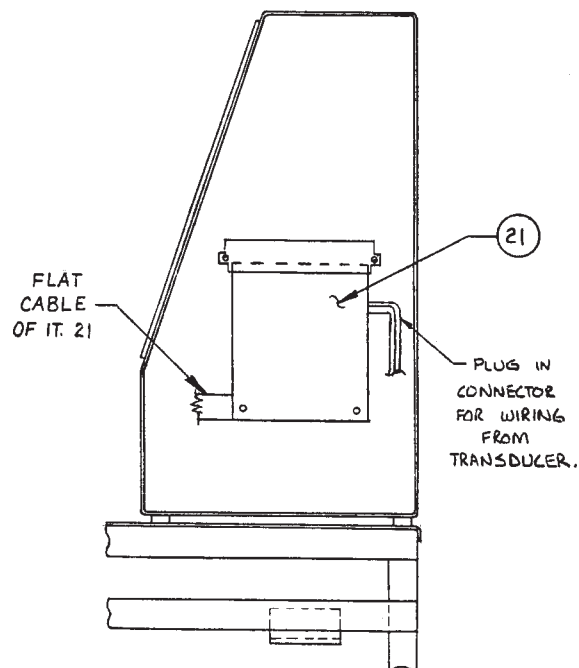
5.1 Console, Front and Side Views

Item*	Description	Part #
21	P.C. board assembly	67-6910
51	gauge, clamp monitor	67-6525
61#	switch, push button, blk. (S-5)	104-0524
65#	switch, Push button (S-6)	104-0536
105**	gauge, 0-200 psi, 4-1/2" dia	67-6334
106**	dial thermometer, 40-100 °F (5-60 °C)	67-6205
109	temp controller, 85-130 °F range	67-6142
112	display board assembly	67-5690
	display parts:	
	toggle switch	104-0348
	display board	67-5689
	LED, red, Fairchild #FLU510	204-2451
	LED 7-segment display, Fairchild	204-2452
205	hour meter, 0-99,999, 230V (60 hz)	04-3795
206	hour meter, 0-99,999, 230V (50 hz)	04-3796
207	neon lamp, 250 VAC/DC amber lens	04-3585
208	neon lamp, 250 VAC/DC red lens	04-3584
209	lamp, incandescent, 28V	04-3520
213	lamp, neon, amber lens with bezel	04-3591
230	pressure indicator	03-6155
237	regulator, 2-150 psig, 1/4 NPT	03-4314
412	transformer, 115/230v, 50/60hz	104-2003

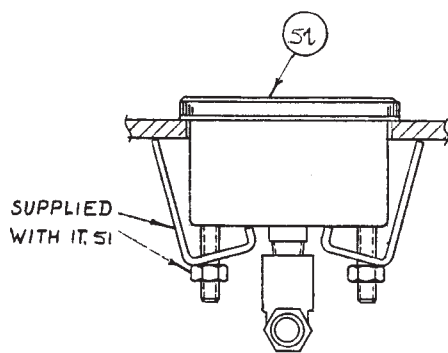
* (based on drawing 67-7622S12R86)

(based on drawing 67-6934S5R28)

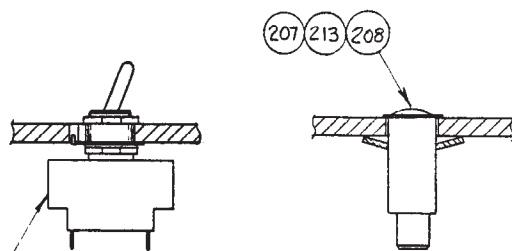
** (New gauges must be set using the CD3 Audit Kit)



SECTION B-B



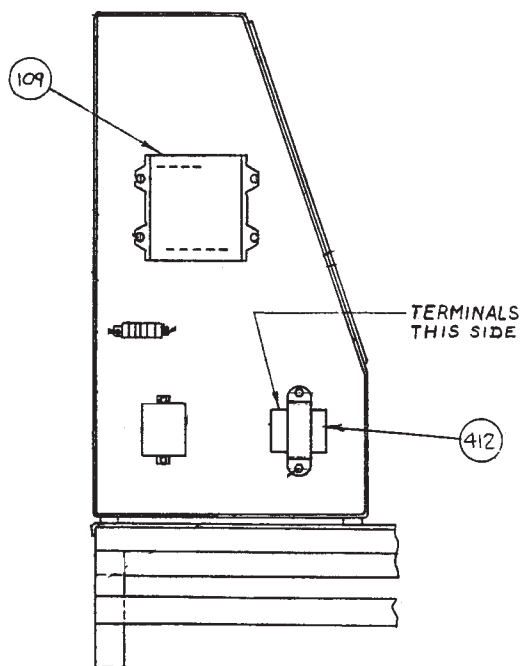
SECTION E-E



SECTION D-D

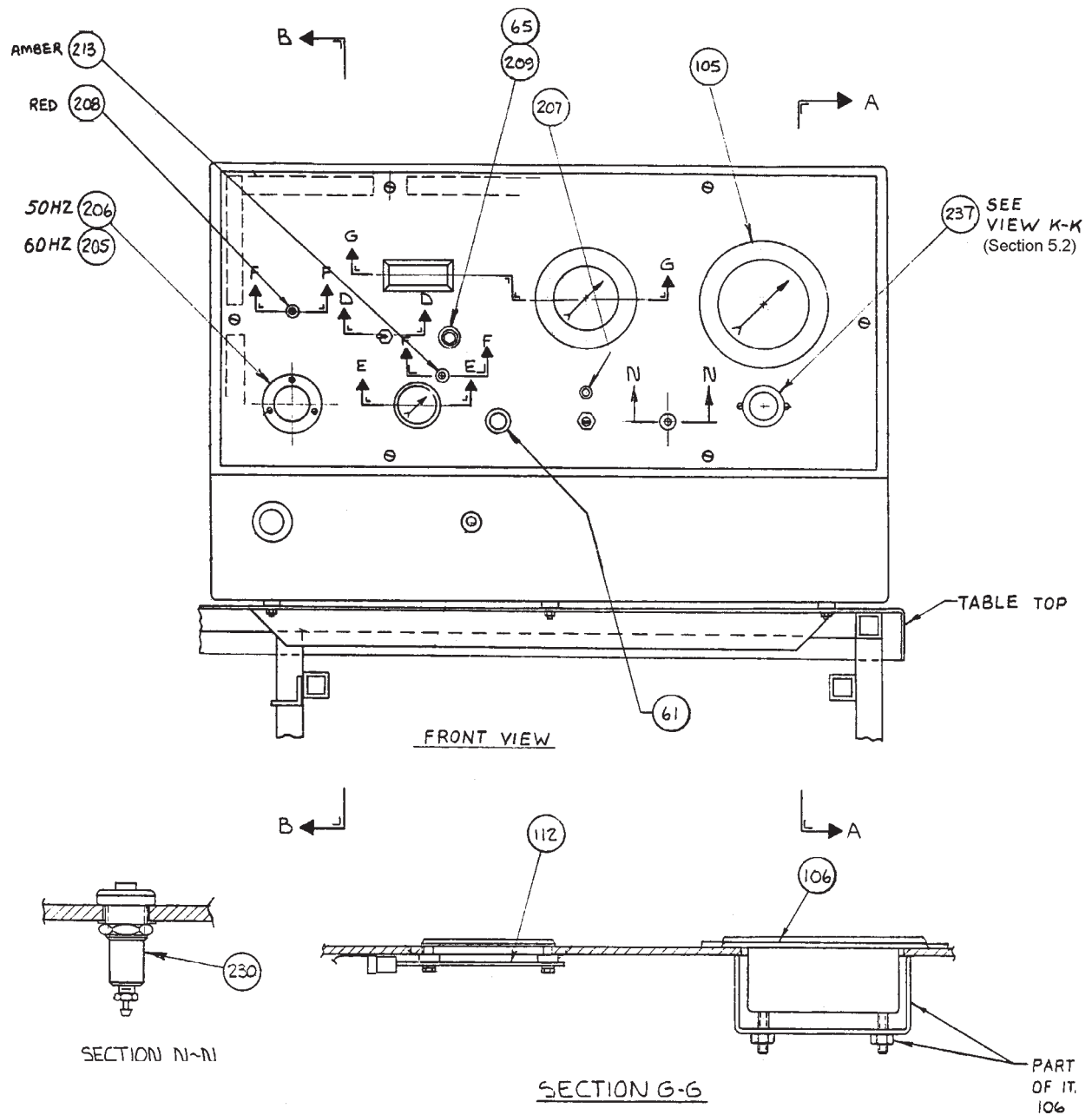
SECTION F-F

(TYP 3 PLCS)



SECTION A-A

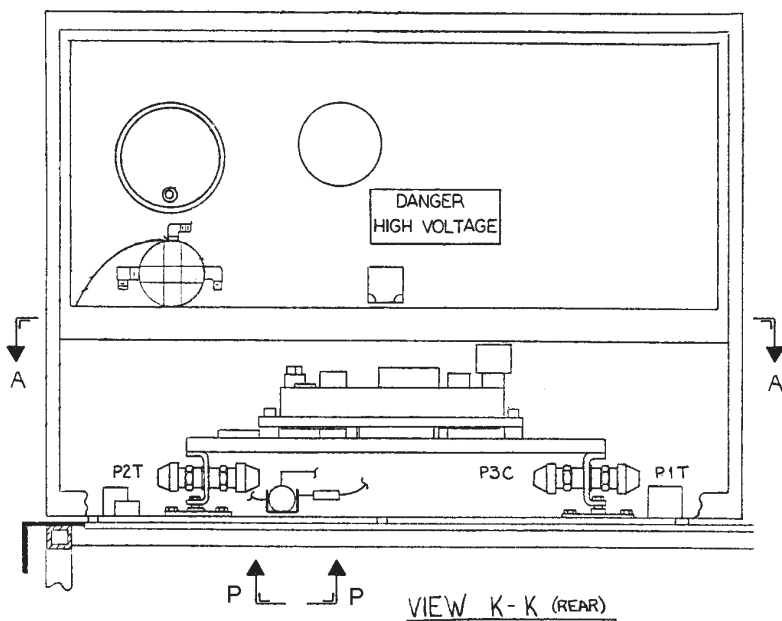
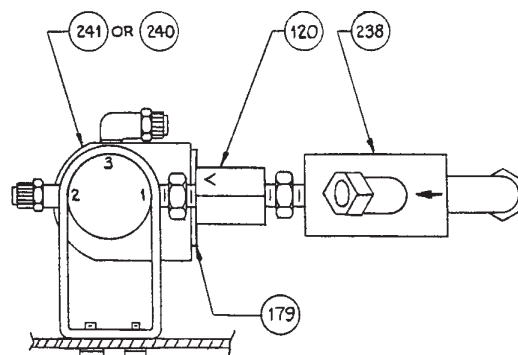
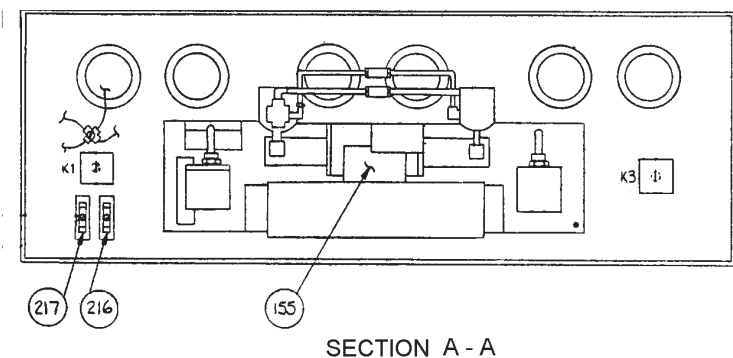
5.1 Console, Front and Side Views (Cont.)



5.2 Console, Rear View

Item*	Description	Part #
120	orifice	67-2395
155	lube oil, SAE 30	06-2553
179	grommet, rubber	05-4618
216	fuse, 5 amp, 250 V, buss mda-5	04-2715
217	fuse, 3AG, slow-blo, 0.4 amp, 250 V	04-2649
238	strainer	03-4254
240	valve, solenoid, #8320 B132-24/50 (50Hz)	03-4220
241	valve, solenoid, #8320 B132-24/60 (60Hz)	03-4213

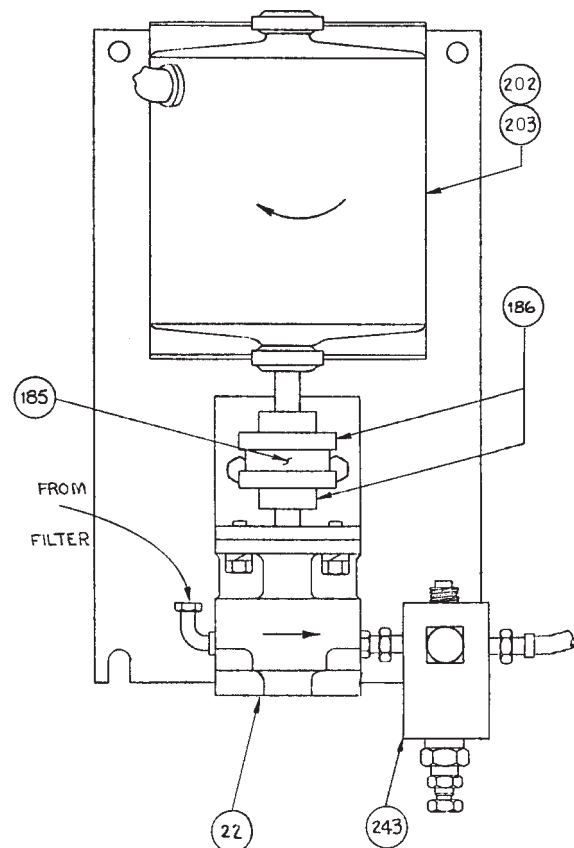
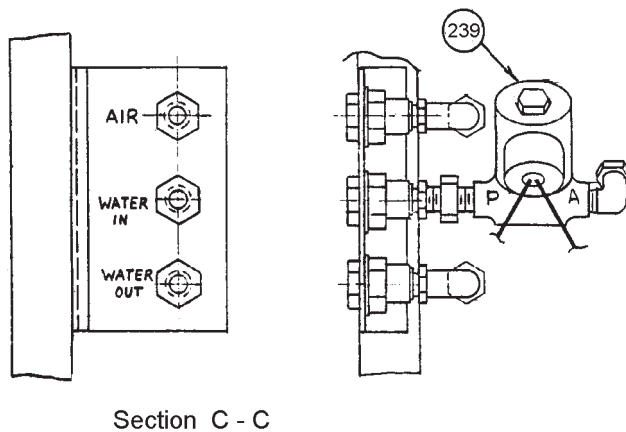
*(based on drawing 67-7622S13R86)



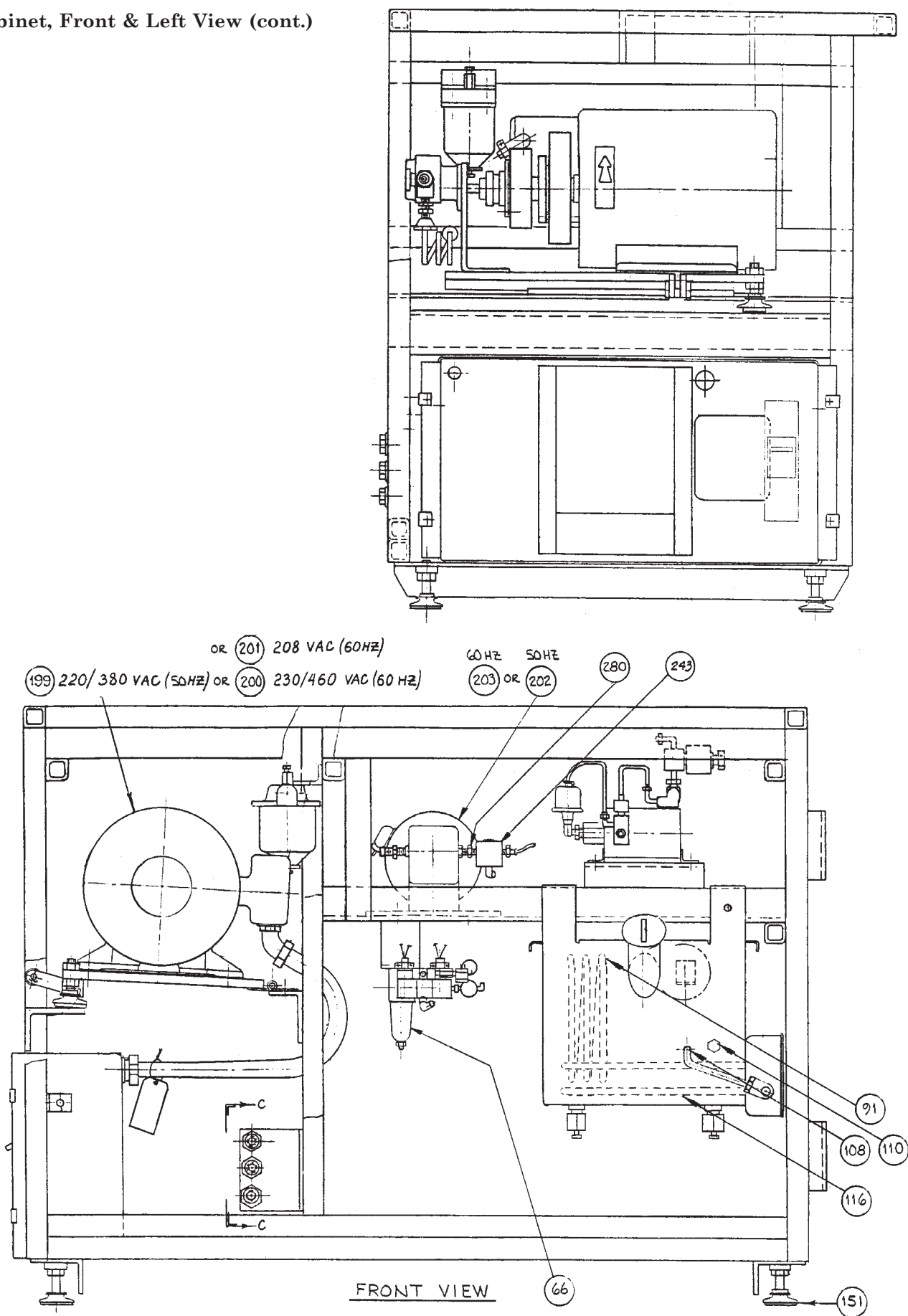
5.3 Cabinet, Front & Left Side View

Item*	Description	Part #
66	pneumatic control assembly, complete	67-6460
	pneumatic control parts:	
	solenoid valve, 3-way, NC 120VA	03-4232
	filter/regulator with gage	07-1576
	switch, pressure, Sigmanetic	104-0587
91	cooling coil	67-6412
108	thermostat	67-6170
110	temperature sensor (350°C max)	67-6141
116	tank heater (500W)	67-5426
199	motor:	
	3 hp, 220/380/440 VAC, 3 phase, 50 Hz	04-4098
	5 hp, 220 VAC, 3 phase, 50 Hz	04-4117
	5 hp, 380 VAC, 3 phase, 50 Hz	04-4116
	5 hp, 440 VAC, 3 phase, 50 Hz	04-4118
200	motor:	
	3 hp, 230/460 VAC, 3 phase, 60 Hz	04-4097
	5 hp, 230/460 VAC, 3 phase, 60 Hz	04-4114
201	motor:	
	3 hp, 208 VAC, 3 phase, 60 Hz	04-4096
	5 hp, 208 VAC, 3 phase, 60 Hz	04-4115
202	motor, 1/3 hp, 110/220 VAC, 50 Hz	04-3995
203	motor, 1/3 hp, 230 VAC, 60 Hz	04-3993
239	valve, skinner, solenoid	03-4222
243	relief valve, RPEC-JEN-FEA	03-4180

*(based on drawing 67-7622S6R86 & S7R86)



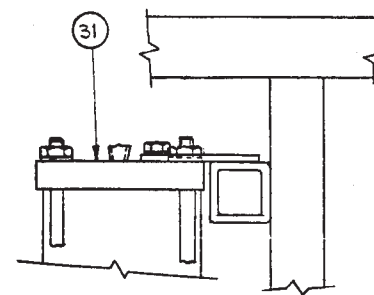
5.3 Cabinet, Front & Left View (cont.)



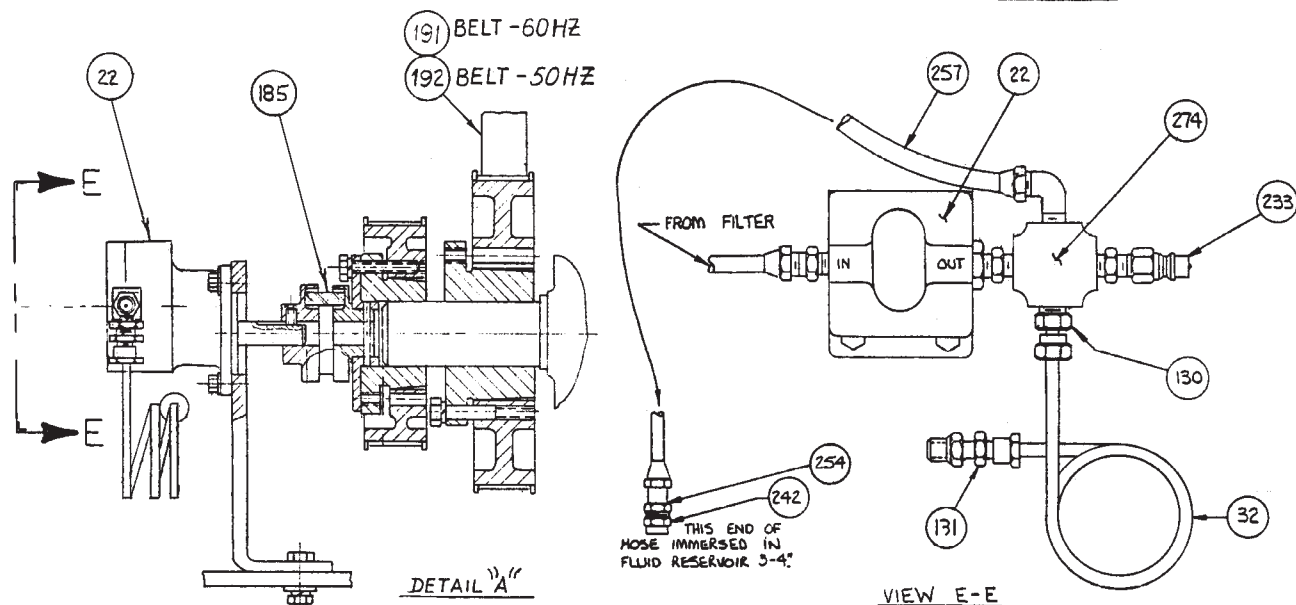
5.4 Cabinet, Top View

Item*	Description	Part #
22	gear pump	67-6902
31	surge chamber assembly	67-6626
	surge chamber replacement parts:	
	O-ring, 3" ID x 3-3/16 OD	05-5186
32	fuel line, .093x24	67-6619
81	intensifier assembly	67-6430
	intensifier parts:	
	solenoid valve, 3-way, NC	03-4211
	air release valve, 2-way, NO	03-4273
	hydraulic pump, air driven	67-6431
	oil reservoir	67-6432
130	connector stud	65-0309
131	connector stud	65-1177
143	filter, final stage, with hardware	07-1621
	(filter cartridge: Fram #C1110PB)	07-1640
144	filter, element (replacement)	07-1618
185	Coupling Sleeve, #3 Flange	05-3450
186	flexible coupling, TB Woods 33	05-3400
191	timing belt, 1/2 pitch (60 Hz)	05-2114
192	timing belt, 1/2 pitch (50 Hz)	05-2113
233	coupling, 2-way shut off plug	03-5352
236	hose, low pressure	03-5108
237	regulator, 20-150 psig, 1/4 NPT	03-4314
242	relief valve, B-4CPA-2-350	03-4181
254	connector, 1/4 polytube x 1/4	103-2982
257	tubing, flexible nylon	03-2913
274	cross, wrought (auto), brass	03-0950
281	check valve, 1/4 NPT	03-4052
420	switch, pressure	104-0586

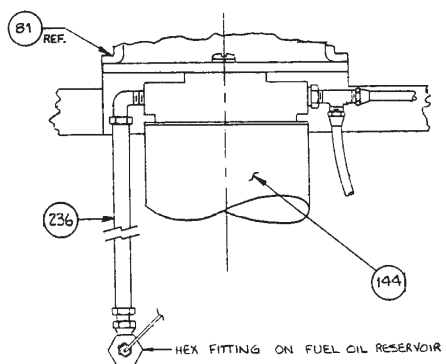
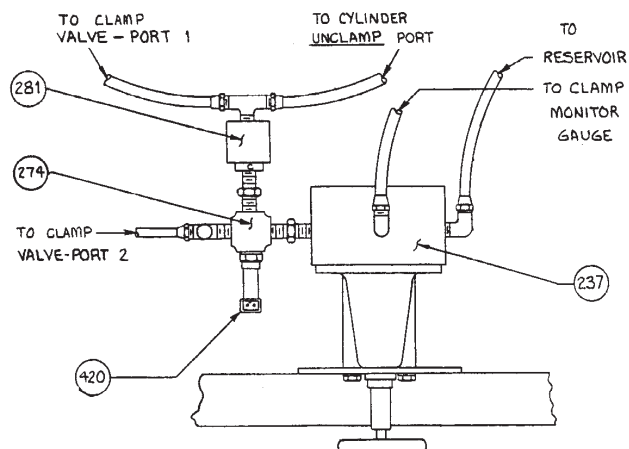
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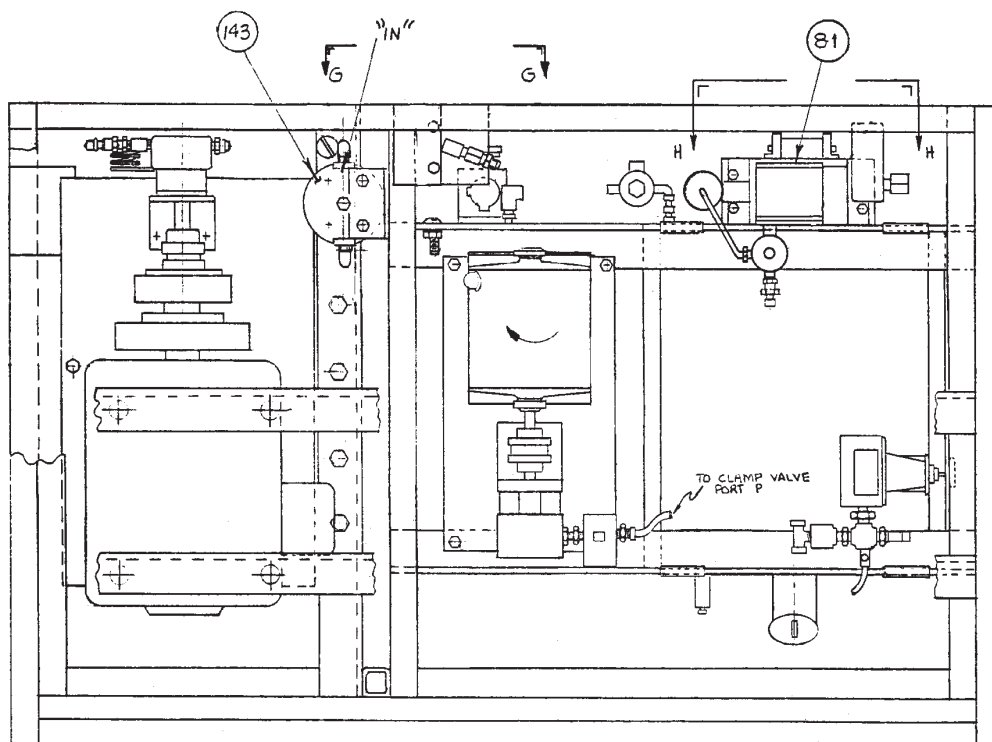
VIEW G-G



5.4 Cabinet, Top View (cont.)



VIEW H-H



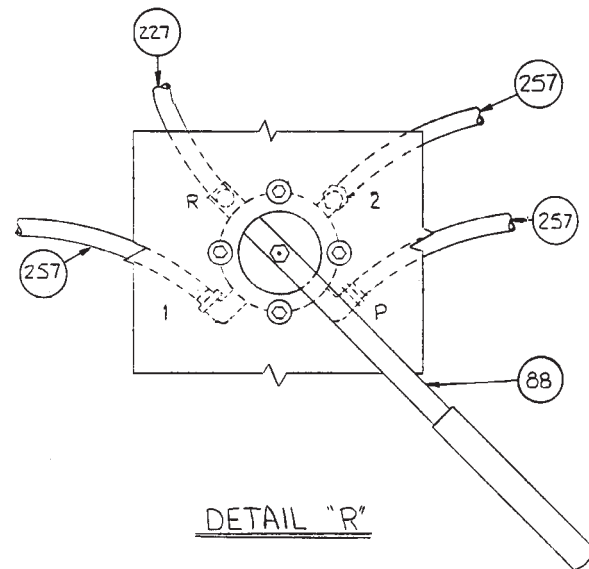
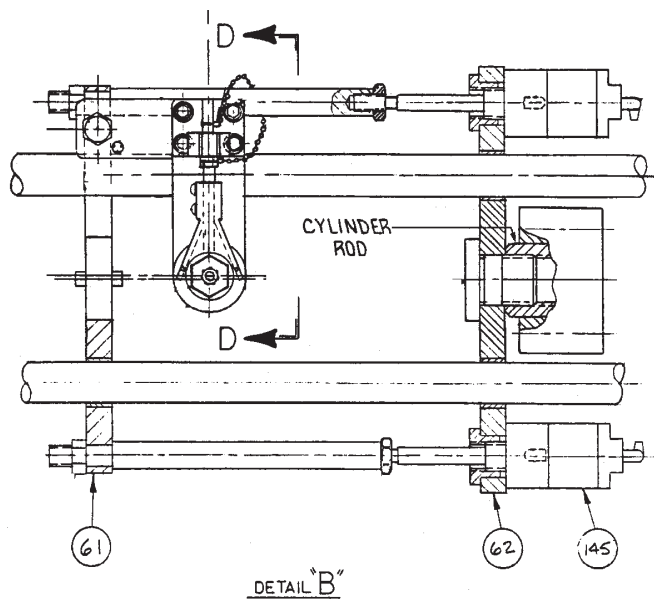
TOP VIEW

5.5 Operator's Table

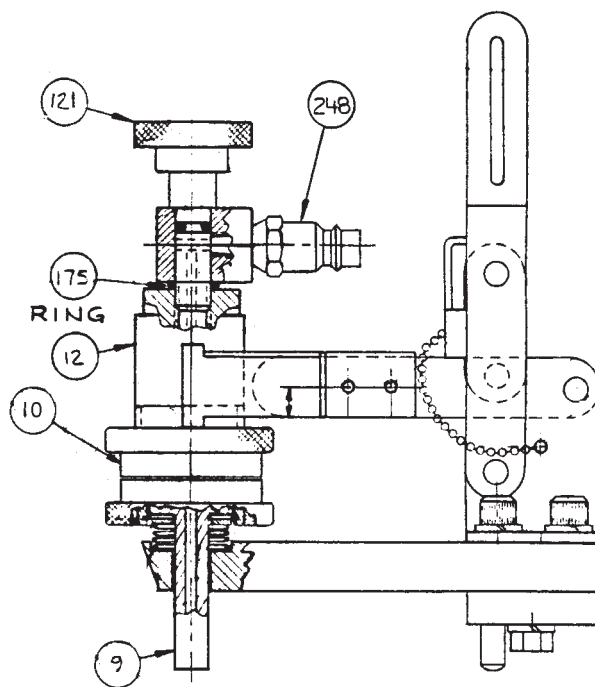
Item*	Description	Part #
12	fuel arm assembly	67-7638
	fuel arm parts:	
9	O-ring	05-5018
10	O-ring	05-5112
16	cambox assembly (see Section 5.7)	67-7619
61	injector carrier plate assembly	67-6473
62	cylinder carriage plate assembly	67-6472
62**	switch, push button, red. (S-4)	104-0540
63**	switch, push button, yel. (S-8)	104-0533
64**	switch, push button, grn. (S-7,10)	104-0534
88	directional control valve	67-6416
94	clamp cylinder	67-6405
121	stem block knob assembly	67-2082
	stem block knob assembly parts:	
	O-ring	05-5110
145	cylinder, pneumatic double acting	07-0982
175	O-ring, Teflon	05-5446
227	hose, low pressure #6 black	03-6013
248	quick connect plug, 1/8 NPT	103-5400
257	tubing, flexible nylon	03-2913

* (based on drawings 67-7622S10R86, S11R86)

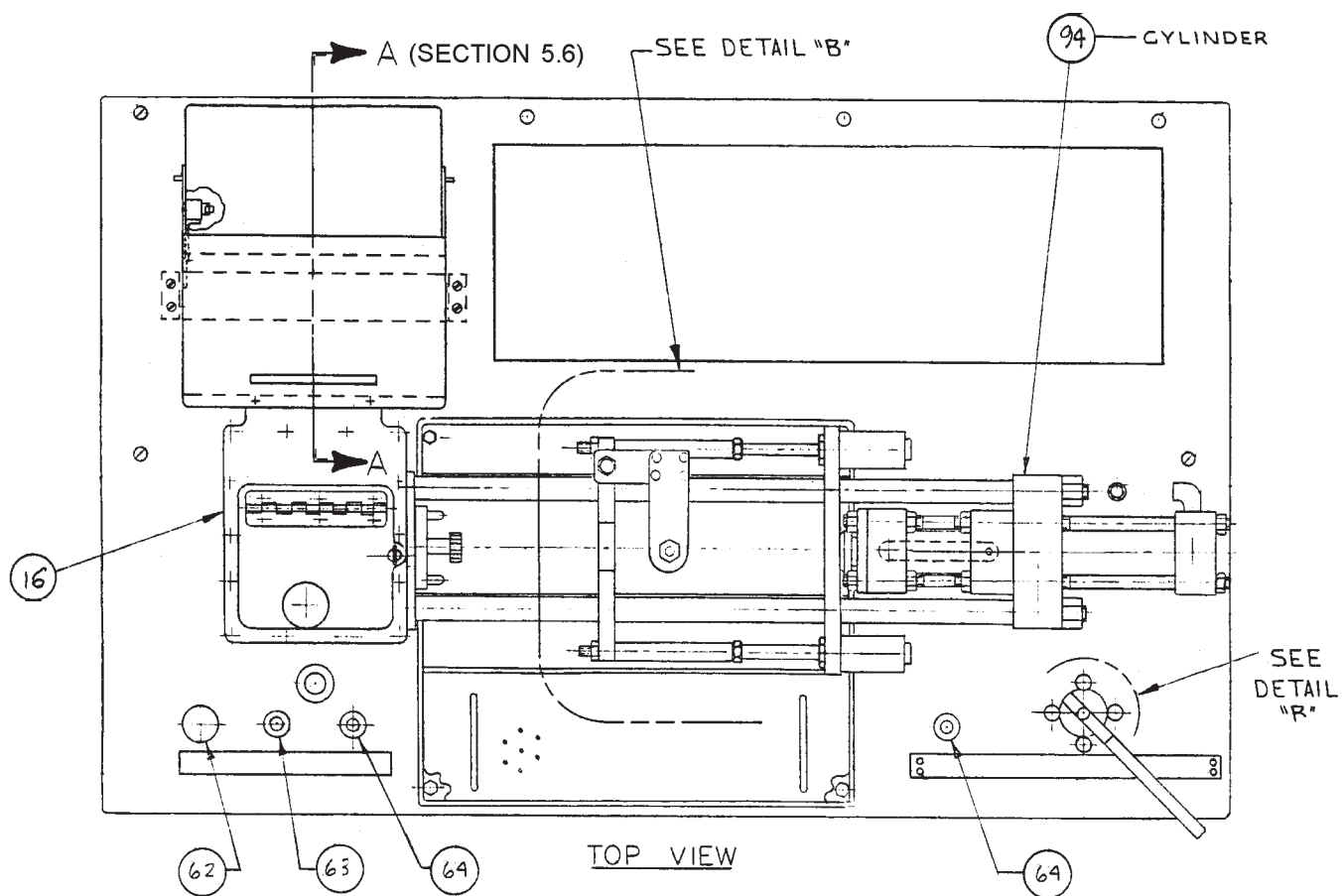
** (based on drawings 67-6934S4R28, & S5R28)



5.5 Operator's Table (cont.)



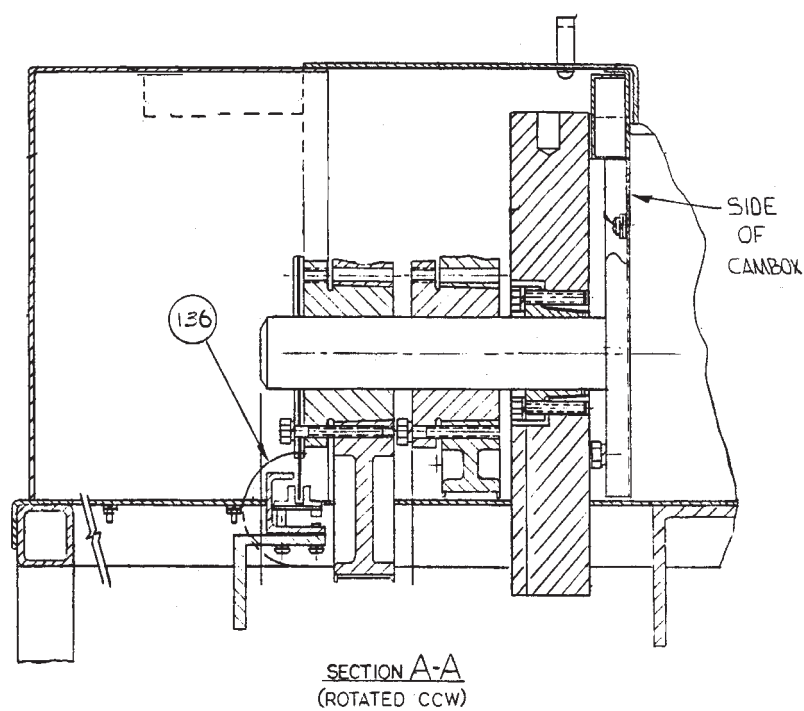
VIEW D-D



5.6 Optical Detector

Item*	Description	Part #
136	optical detector assembly	60-7000

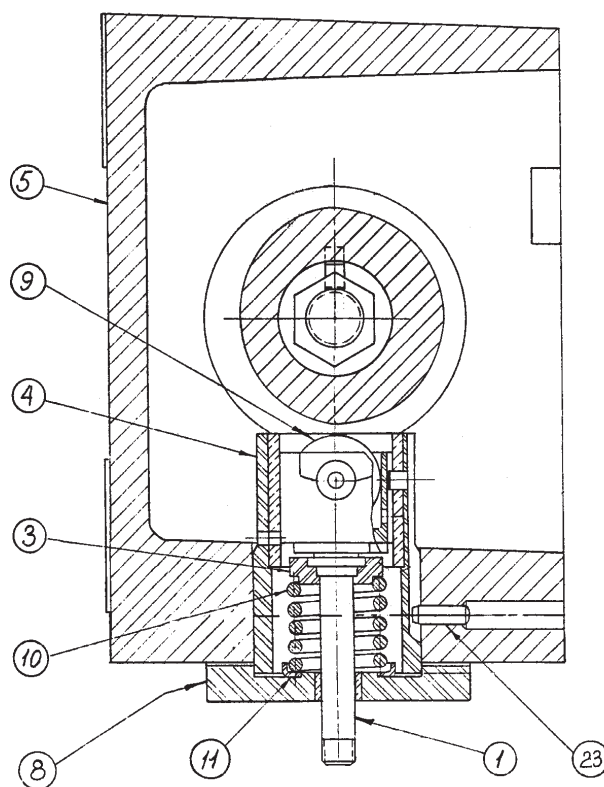
*(based on drawings 67-7622S10R86)



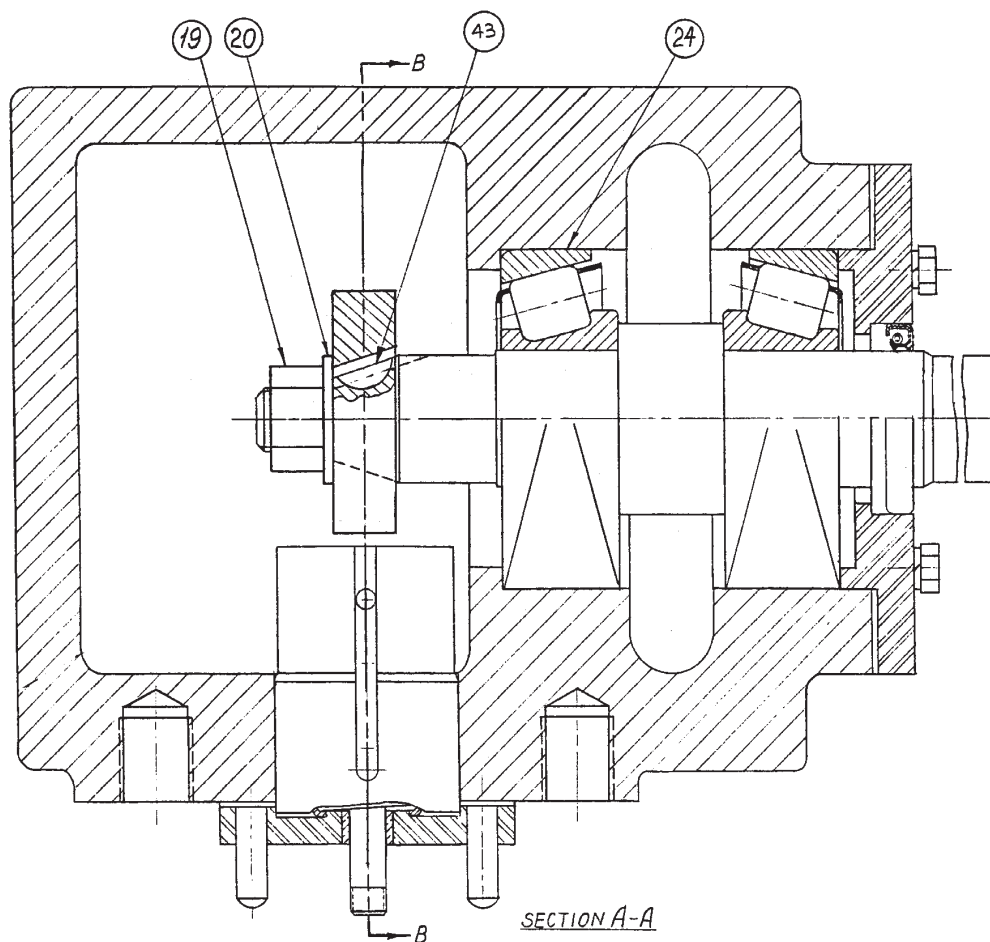
5.7 Cambox Assembly

Item*	Description	Part #
1	pusher rod	67-5704
3	spring lower seat	67-5713
4	cam follower sleeve assembly	67-5716
5	cambox	67-6374
8	push rod guide	67-6417
9	tappet assembly	67-6418
10	spring	67-6419
11	spring upper seat	67-6420
19	hex nut, 3/4-16	02-3159
20	plain washer, 3/4	02-4158
23	dowel pin, 1/4x3/4	02-5532
24	bearing taper roller	05-1102
43	woodruff key #91	05-4516

*(based on drawings 67-7619S2R17)



SECTION B-B



SECTION A-A

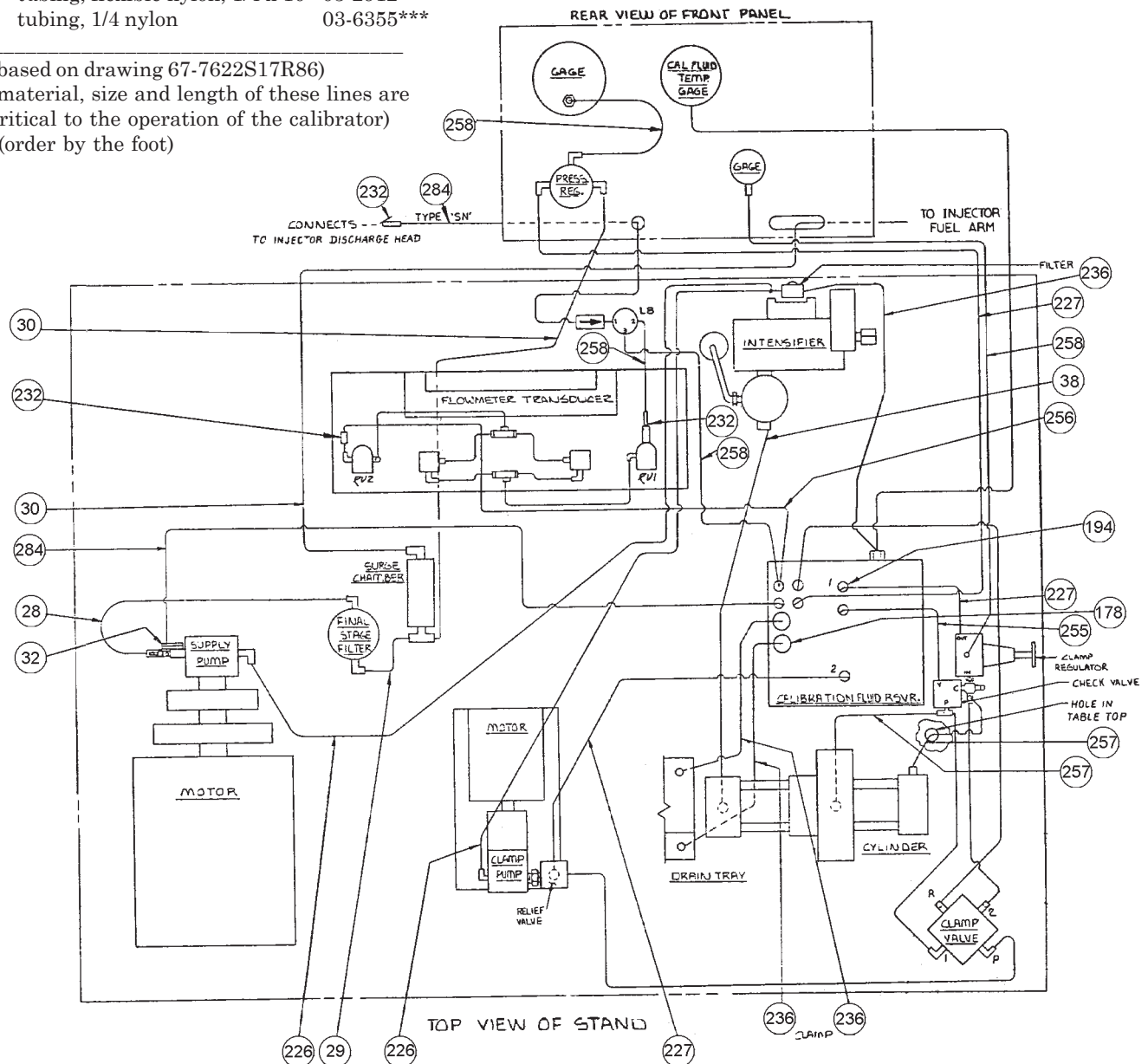
5.8 Calibration Fluid Plumbing System

Item*	Description	Part #
28**	hose assembly, 12"	67-6629
29**	hose assembly, 18"	67-6628
30**	hose assembly, 35"	67-6627
32**	fuel line, .093x24	67-6619
38	fuel line, high pressure	67-6548
178	grommet, rubber	05-4620
194	grommet, rubber	05-4615
226	hose, low pressure #6 black	03-5106***
227	hose, low pressure #6 clear	03-6013***
232	insert, quick connect, 1/4 O.D.	03-5400
236	hose, low pressure	03-5108***
255	polyflo tubing, 3/8	03-2940***
256	polyurethane tubing, 1/4 x.062	03-2920***
257	tubing, flexible nylon	03-2913***
258	tubing, flexible nylon, 1/4 x 10	03-2912***
284	tubing, 1/4 nylon	03-6355***

* (based on drawing 67-7622S17R86)

** (material, size and length of these lines are critical to the operation of the calibrator)

*** (order by the foot)

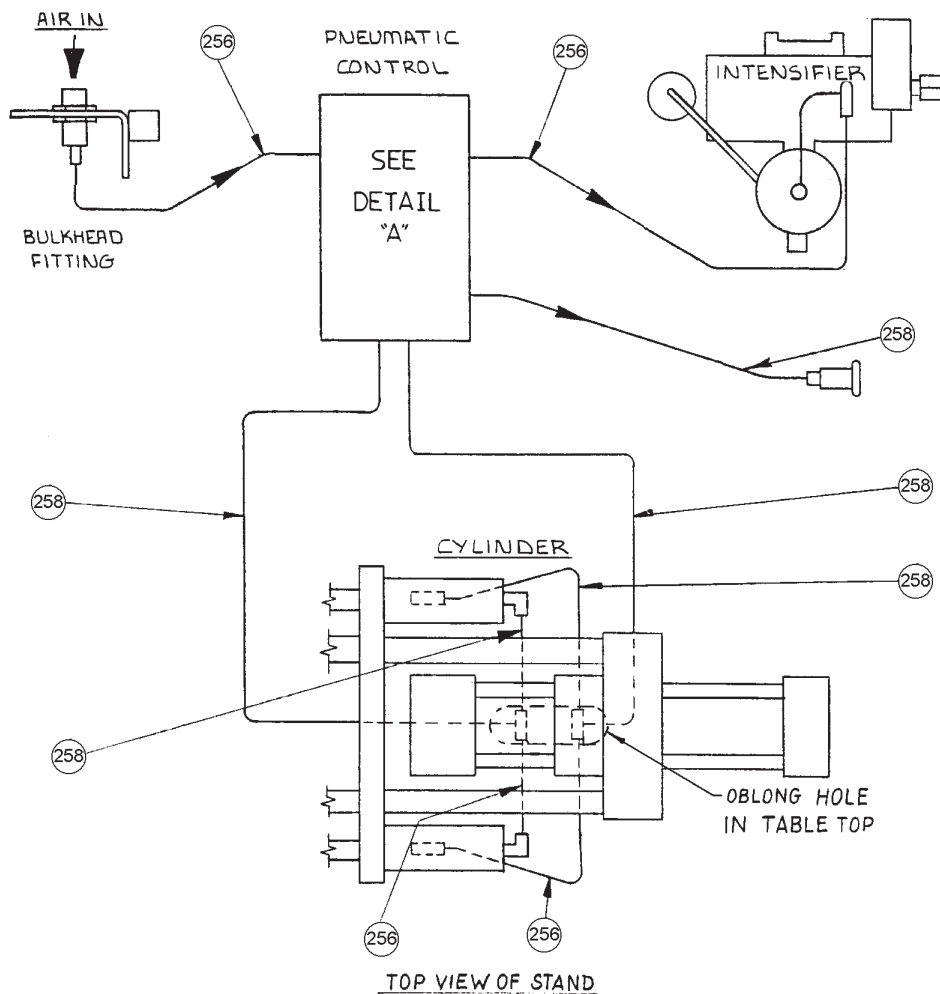
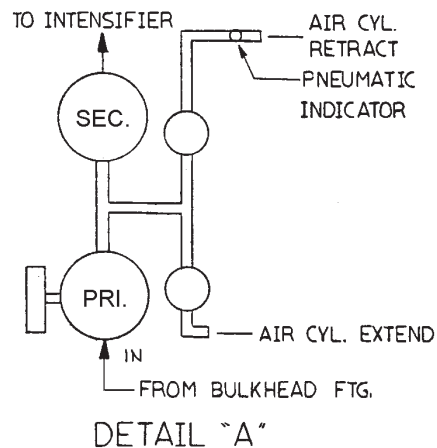
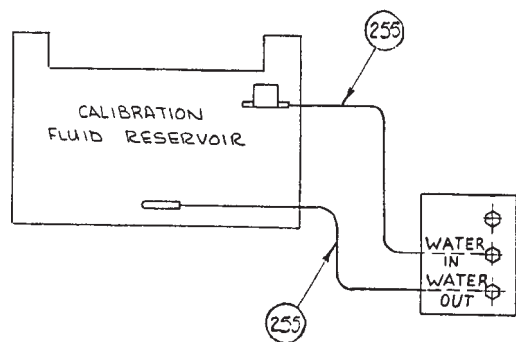


5.9 Pneumatic and Hydraulic Plumbing Systems

Item*	Description	Part #
255	polyurethane tubing, 3/8	03-2940**
256	polyflo tubing, 1/4x.062	03-2920**
258	tubing, flexible Nylon 1/4 x 10	03-2912**

* (based on drawing 67-7622S18R86)

** (order by the foot)



5.10 Calibrator Wiring Harness

Item*	Description	Part #
60	relay (K-2)	04-5298
61	switch, push button, blk. (S-5)	104-0524
62	switch, push button, red. (S-4)	104-0540
63	switch, push button, yel. (S-8)	104-0533
64	switch, push button, grn. (S-7,10)	104-0534
65	switch, push button, (S-6)	104-0524
66	potentiometer, 3W, 6 Ohm (R1)	204-4593
67	relay (K-1)	04-5187
79	relay, time delay (K-1)	04-5254
109	temp controller, 85-130° F	67-6142
112	display Board Assy., calibrator	67-5690
207	neon lamp, 250VAC/DC, amber	04-3585
209	lamp, incandescent, 28V	04-3520
213	lamp, neon, amber	04-3591
412	transformer, 115/230V, 50/60 Hz	104-2003

* (based on drawings 67-6934S4R28 & S5R28,
also 67-7622S14R86 & S15R86)

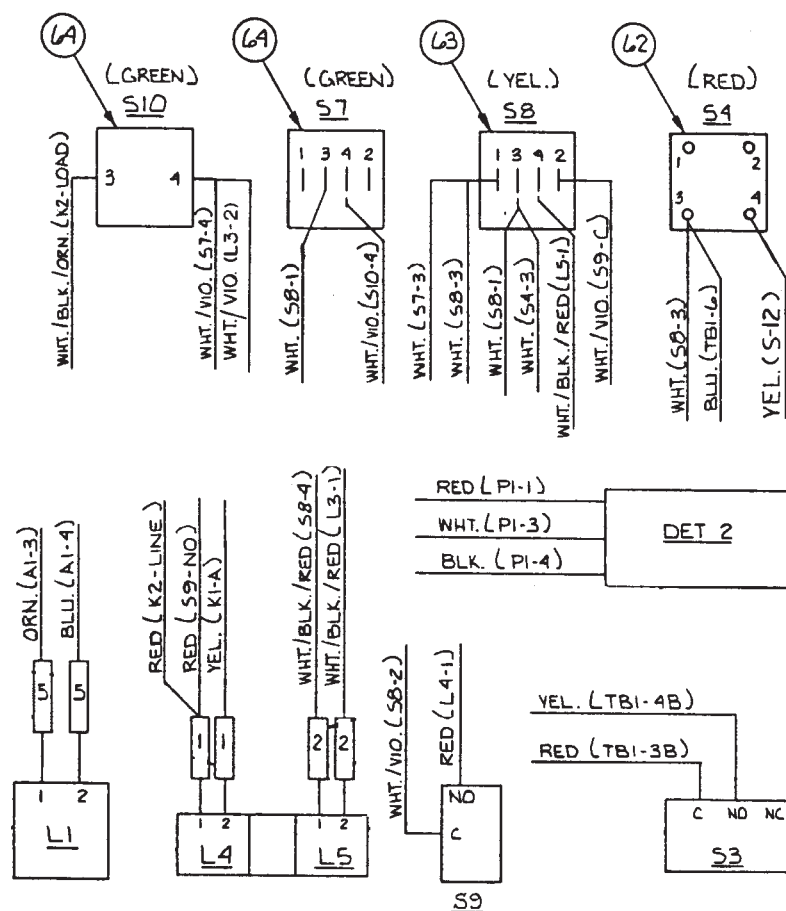
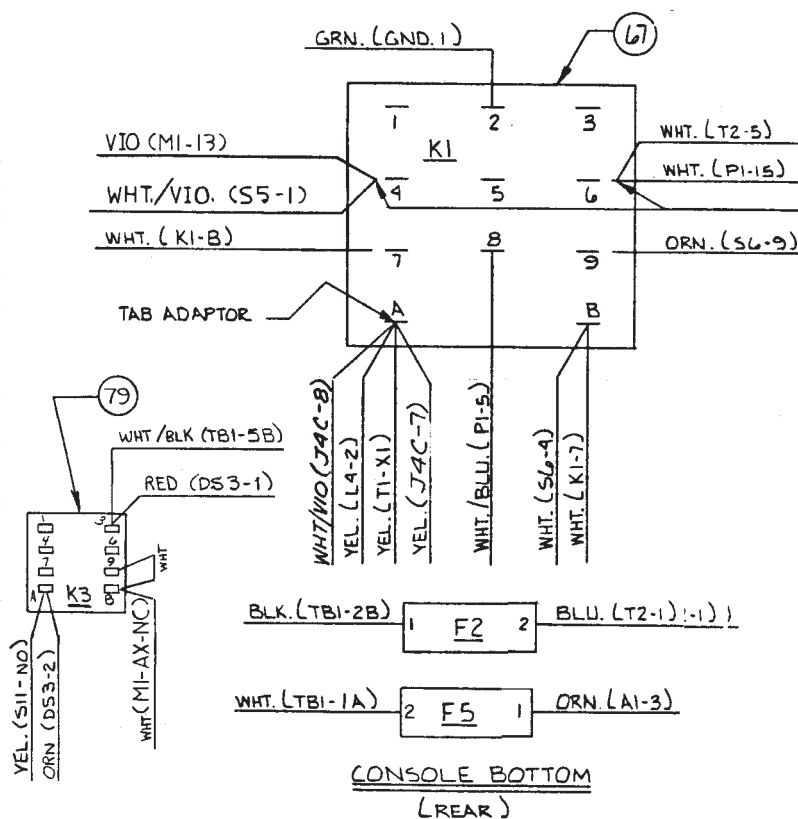
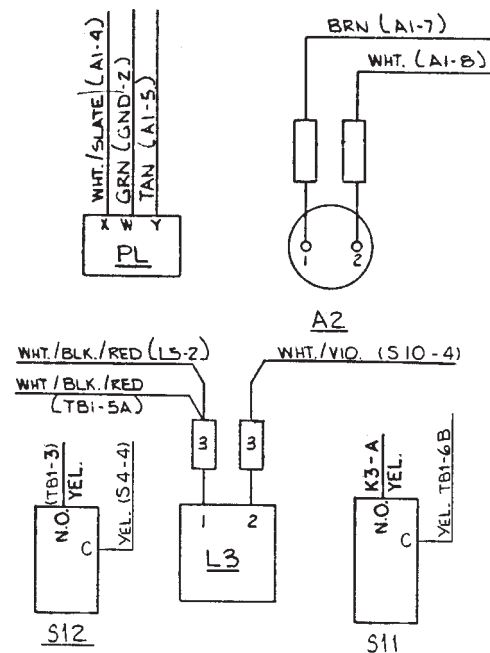
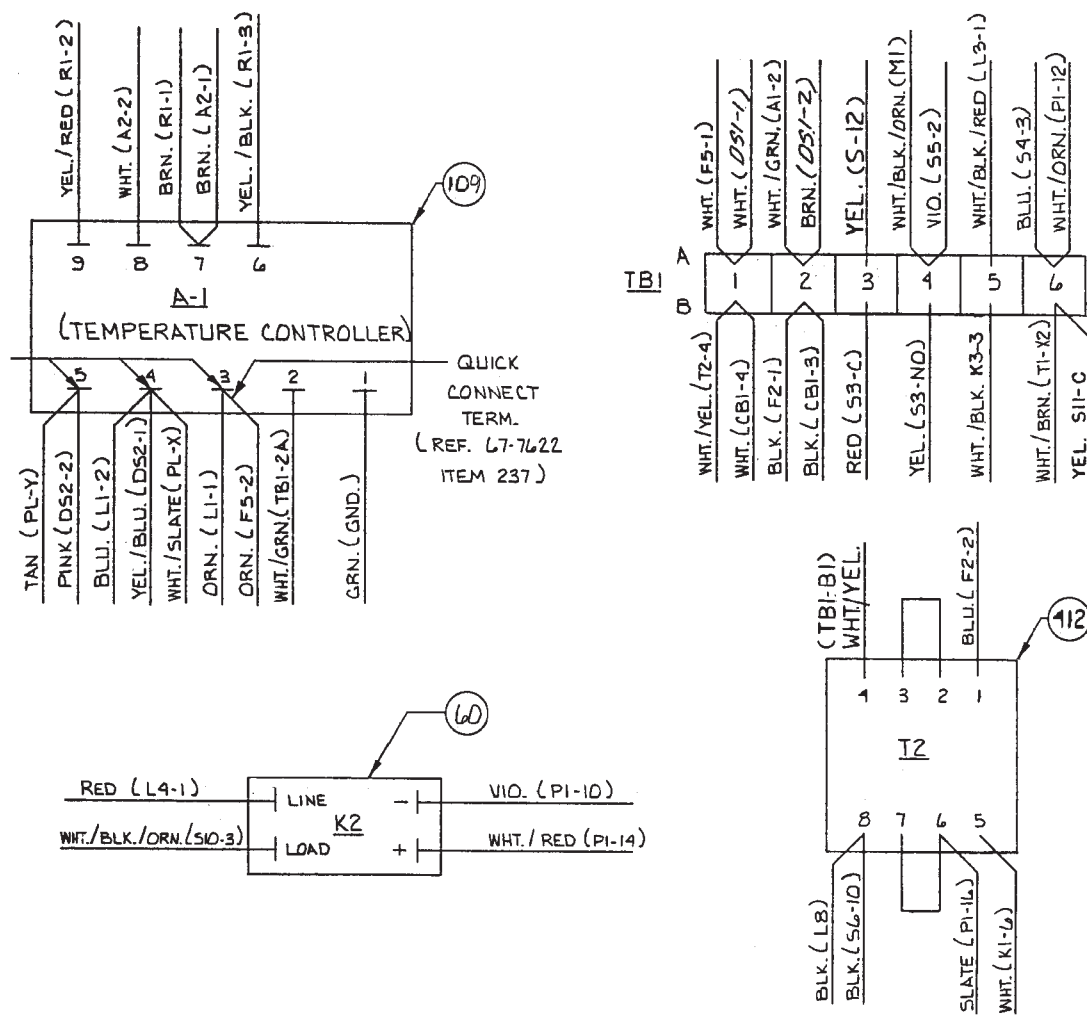


TABLE TOP + FRAME VIEWED FROM ABOVE (REAR)

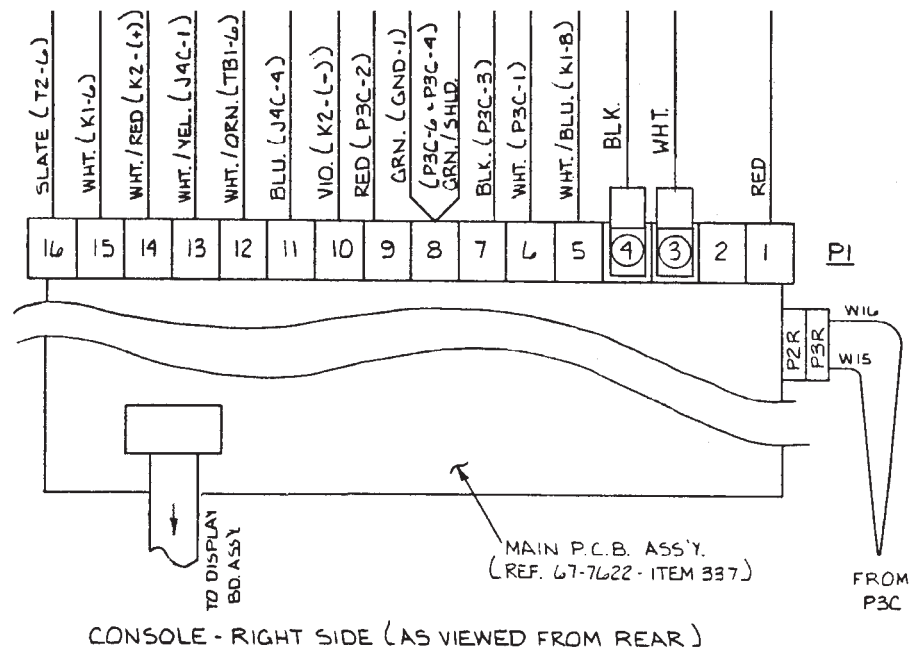
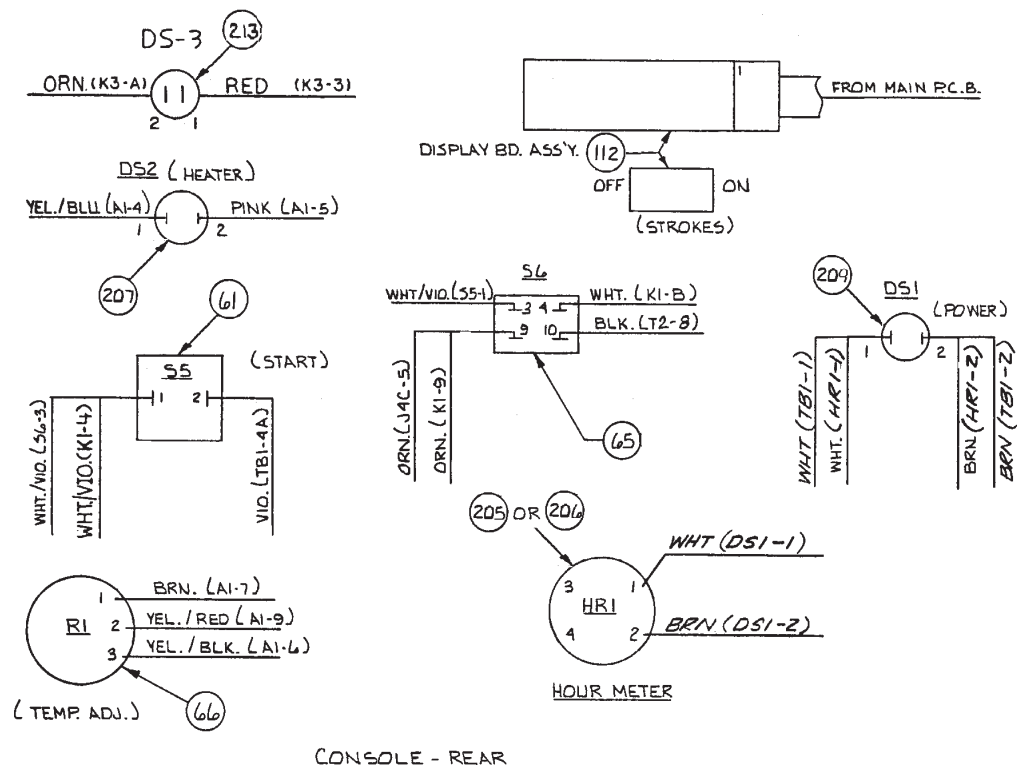


5.10 Calibrator Wiring Harness (cont.)



CONSOLE-LEFT SIDE (AS VIEWED FROM REAR)

5.10 Calibrator Wiring Harness (cont.)

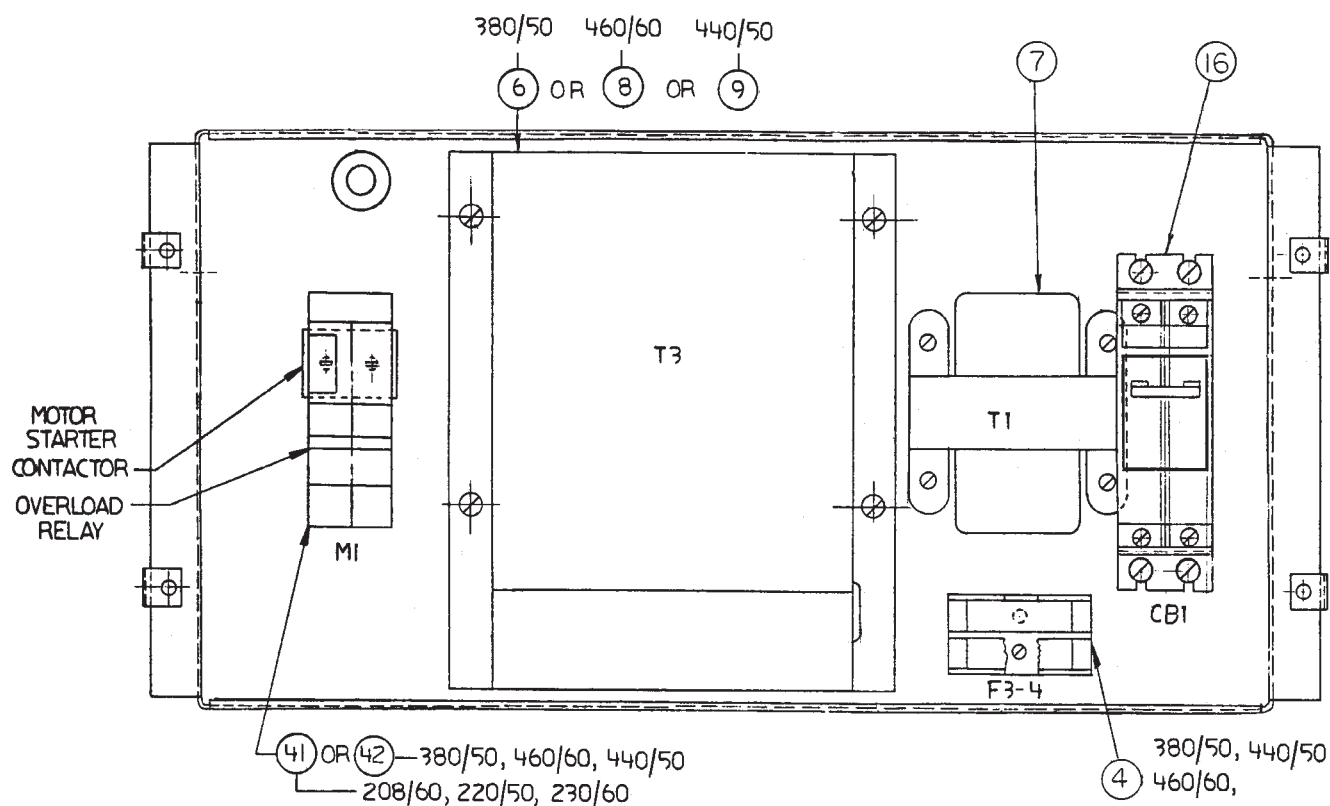


5.11 Electrical Control Panel

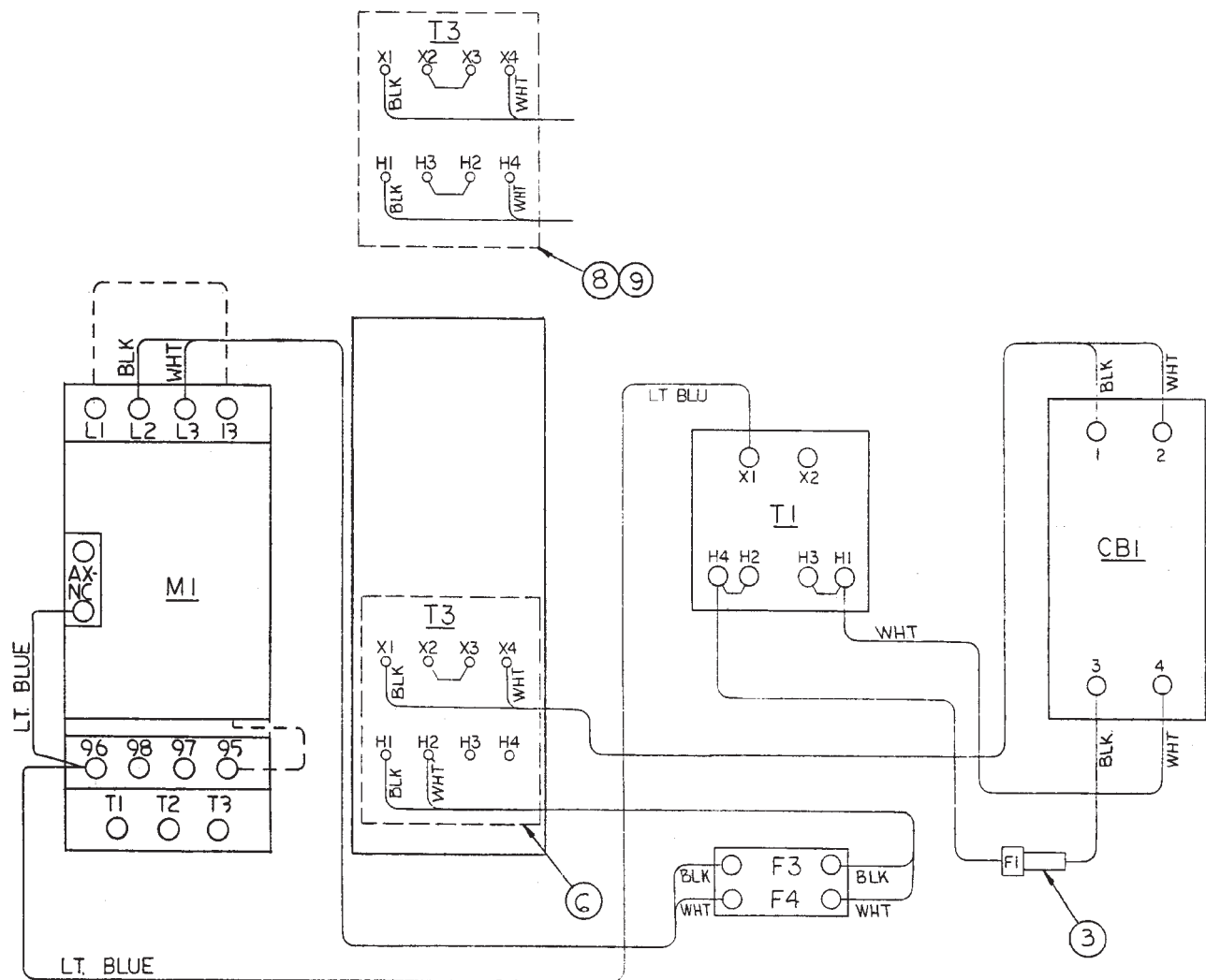
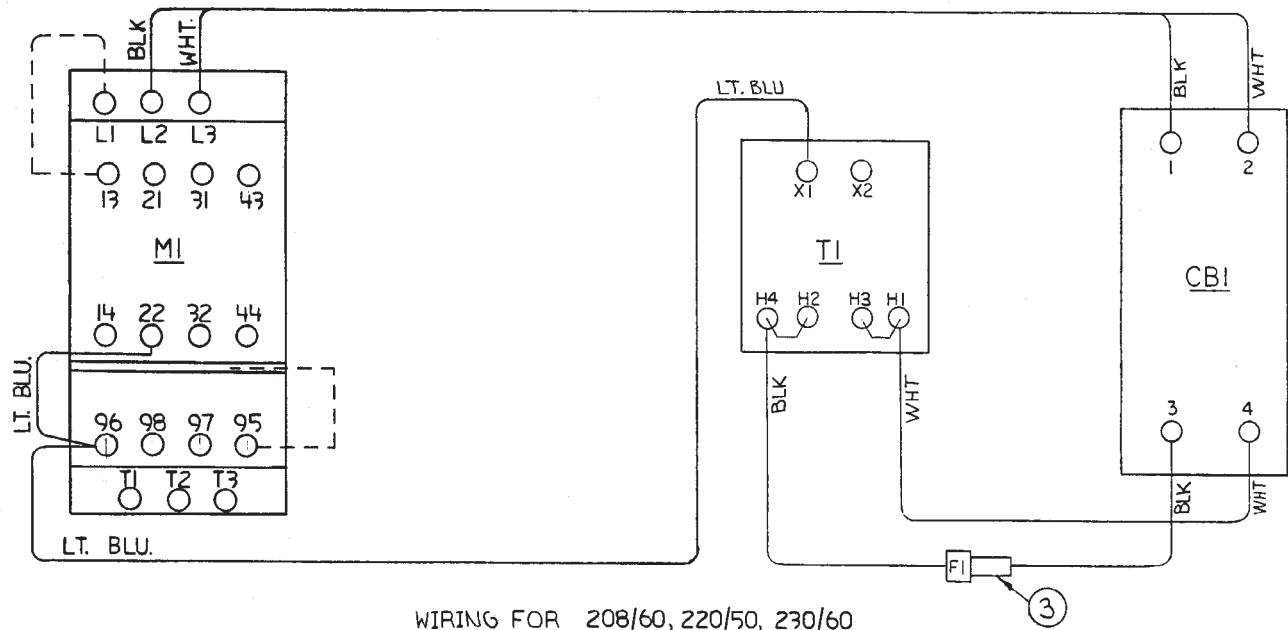
Item*	Description	Part #
3	fuse, 2 amp, 250V (F1)	404-2709
4	fuse, 5 amp, 500V (F3-4)	404-2717
6**	transformer, pri. 330/400/416V, 50/60hz	104-1946
7	transformer, pri. 230/460V, 50/60hz	104-1944
8**	transformer, pri. 240/480V, 60hz	104-1906
9**	transformer, pri. 240/480V, 50/60hz	104-1913
16	circuit breaker	04-1308
41	starter:	
	3 hp motor, 208/60, 220/50, 230/60	104-0089
	5 hp motor, 208/60, 220/50, 230/60	104-0097
42	starter:	
	3 hp motor, 380/50, 440/50, 460/60	104-0090
	5 hp motor, 380/50, 440/50, 460/60	104-0089

* (based on drawings 67-7634S1R19 & 67-7634S2R19)

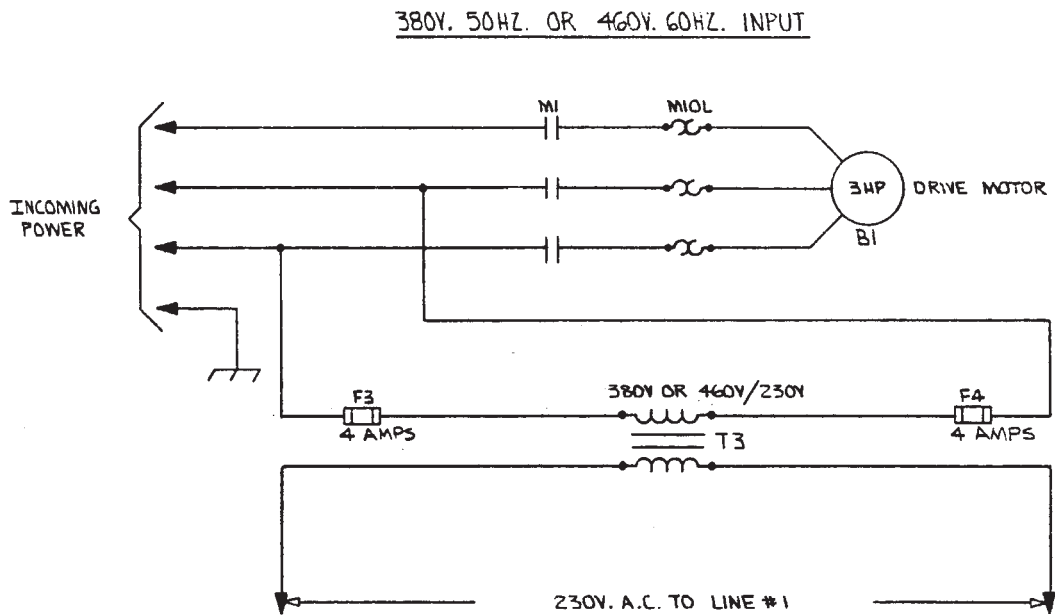
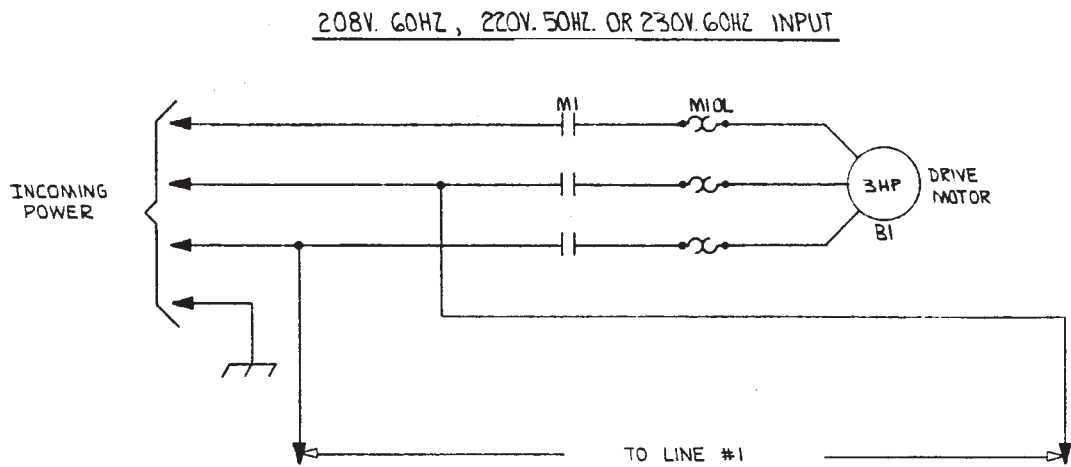
** (for voltage options other than 230V, 60Hz)



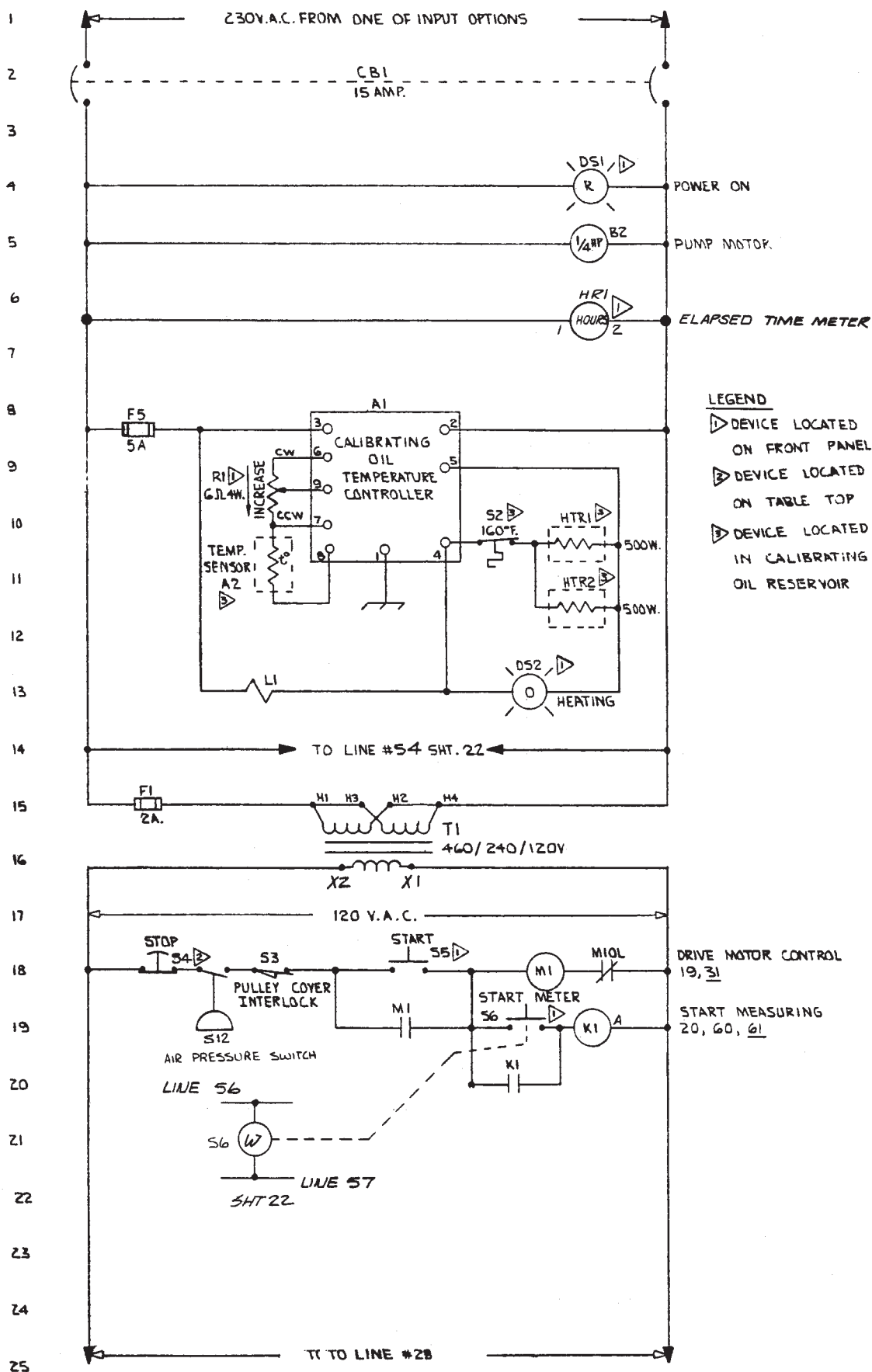
5.11 Electrical Control Panel (cont.)



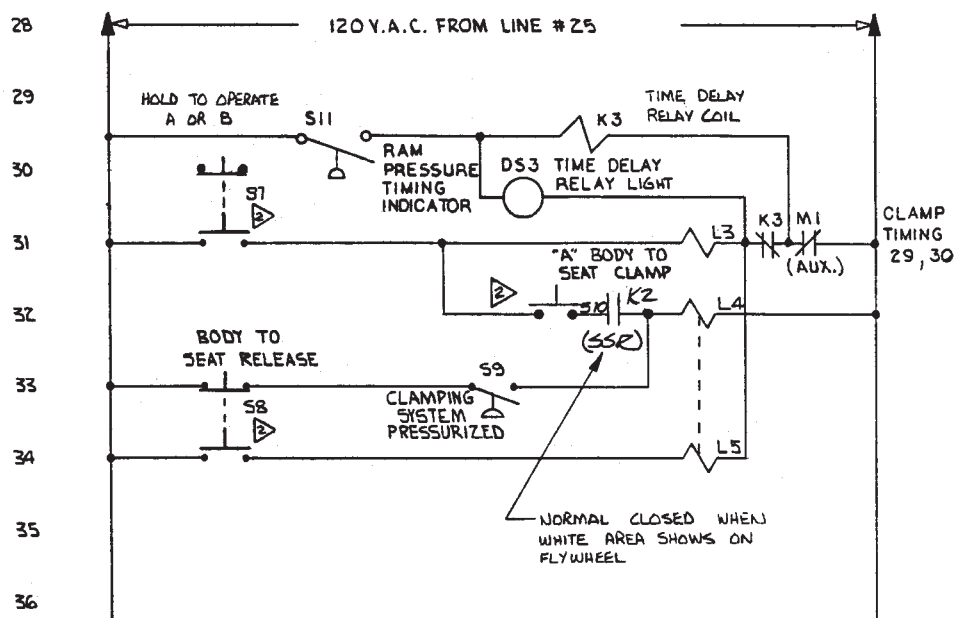
5.12 Electrical Power System



5.12 Electrical Power System (cont.)



5.12 Electrical Power System (cont.)

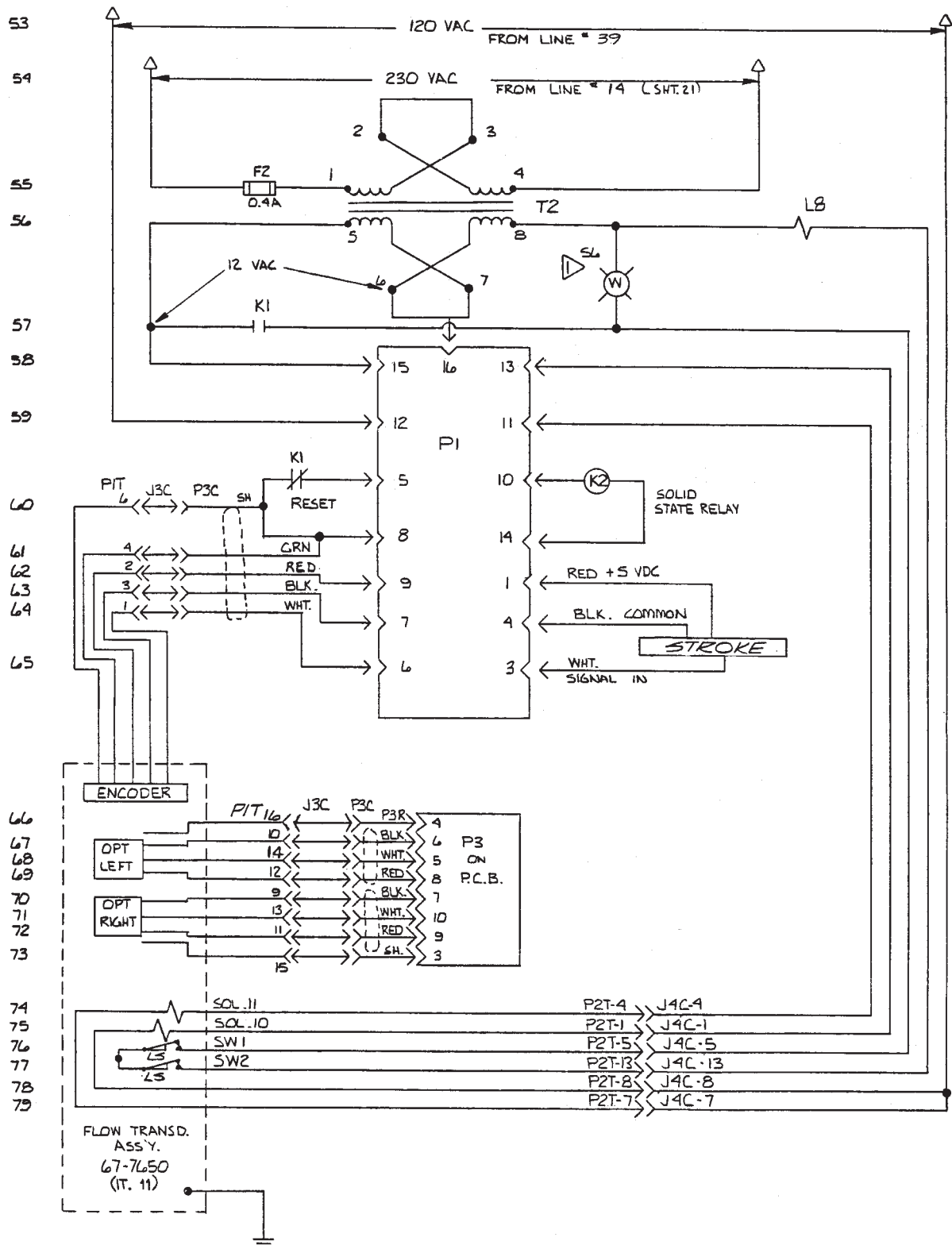
LEGEND:

- ▷ DEVICE LOCATED ON FRONT PANEL.
- ▷ DEVICE LOCATED ON TABLE TOP.

SOLENOID VALVE FUNCTIONS:

- L1 ENERGIZED - CALIBRATION FLUID COOLING WATER FLOWS.
DE-ENERGIZED - CALIBRATION FLUID COOLING WATER STOPPED.
- L2 ENERGIZED - VENTS INTENSIFIER - LOCKS HYDRAULIC CYLINDER.
DE-ENERGIZED - CLOSSES INTENSIFIER RETURN - UNLOCKS HYD. CYLINDER
- L3 ENERGIZED - AIR TO INTENSIFIER
DE-ENERGIZED - AIR CLOSED TO INTENSIFIER
- L4 ENERGIZED - AIR CYLINDERS RETRACT.
DE-ENERGIZED - AIR CYLINDERS HOLD POSITION.
- L5 ENERGIZED - AIR CYLINDERS EXTEND.
DE-ENERGIZED - AIR CYLINDERS HOLD POSITION.
- L6 ENERGIZED - CALIBRATING FLUID TO LEFT CYLINDER.
DE-ENERGIZED - LEFT CYLINDER EXHAUST TO TANK.
- L7 ENERGIZED - CALIBRATING FLUID TO RIGHT CYLINDER.
DE-ENERGIZED - RIGHT CYLINDER EXHAUST TO TANK.
- L8 ENERGIZED - CALIBRATION FLUID FLOWS TO LEFT OR RIGHT CYLINDER
DE-ENERGIZED - CALIBRATION FLUID FLOWS TO TANK.

5.12 Electrical Power System (cont.)

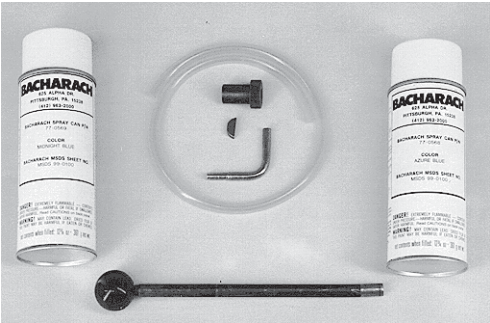


5.13 Basic Calibrator Accessories

All accessories listed below come as a set under part number 67-6547.

Item*	Description	Part #
1	Barring tool	67-6469
2	Fill tube	67-5292
3	Key, Woodruff #91, 1/4x3/4 (spare)	05-4516
4**	O-rings, Teflon, ARP #568-111	05-5446
5**	O-rings, .145 ID x 9/32 OD	05-5018
6	Tubing, vinyl 1/4 ID x 1/16 W	03-6063
7	Lock, push rod	67-5712
8	Touch-up paint, azure blue	77-0568
9	Touch-up paint, midnight blue	77-0569

* (based on drawing 67-6547S1R8)
** Not shown



5.14 Accessories for use with Cummins Injectors

A complete set of Cummins accessories can be ordered under part number 67-7633. The complete set comes with pegboard hooks for hanging the accessories inside the cabinet door.

Item*	Description	Part #
1	discharge head	67-7642
2	push rod extension	67-5706
3	adapter (N-NH,J-C)	67-6368
4	adapter (3/8 PTB-PTC)	67-6604
5	adapter (5/16 PTB-PTC)	67-6602
6	adapter (3/8 PTD)	67-6348
7	adapter (5/16 PTD)	67-6350
8	adapter (K-PTD)	67-6351
9	adapter (PTD-TS)	67-6349
10	adapter (L-10/TS) (not shown)	77-0825
11	push rod (N-NH)	67-6575
12	push rod (J-C)	67-6576
13	push rod (PTB-PTC)	67-6577
14	push rod (PTC LG. RAD)	67-6574
15	push rod link (for PTD, K-PTD)	67-5703
16	drain connection H-NH, J-C	67-6580
17	locating pin	67-6519
18	cam 310	67-6369
19	cam 169	67-6870
20	cam 230	67-6861
21	O-ring (spares) (not shown)	05-5005
22	shear pin (spares) (not shown)	67-5702
23	Injector Adapter (K-HVT) (not shown)	67-6997
24	cam 248 (not shown)	77-0629
25	adapter (L10-STC) (not shown)	77-0891
26	cam 272 (not shown)	77-0823
27	cam 426 (not shown)	77-0824

* (based on drawings 67-7633S1R14 & S2R14)



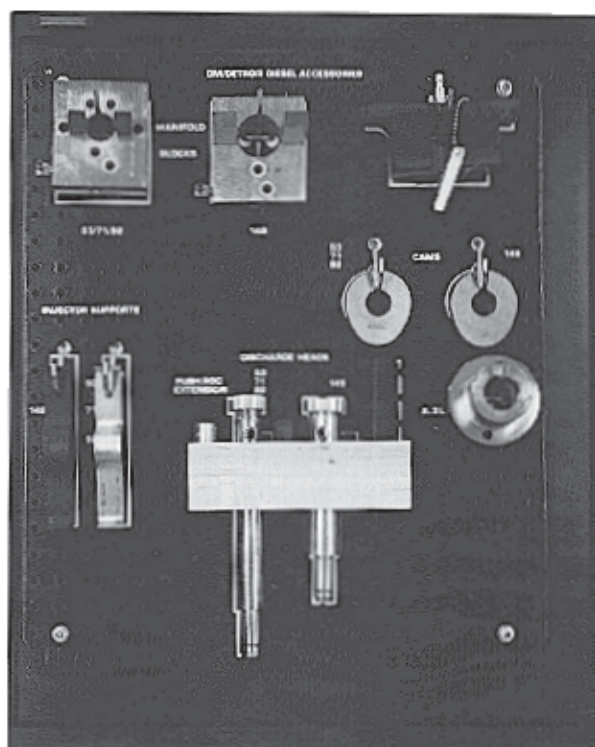
5.15 Accessories for use with DD Injectors

A complete set of DD accessories may be ordered under part number 67-7632. The complete set comes with pegboard hooks for hanging the accessories inside the cabinet door.

Item	Description	Part #
1	manifold block (53,71,92)	77-0613
2	manifold block (149)	67-7643
3	front support (53,71,92)	67-6606
4	front support (149)	67-6605
5	injector holder assembly (8.2L)	67-8525
6	discharge head (53,71,92)	67-5696
7	discharge head (149)	67-5700
8	cam (53,71,92)	77-0610
9	cam (149)	67-6372
10	push rod extension	67-5708
11	O-rings	05-5109
12	O-rings	05-5113
13	seal (spare for 53,71,& 92)	67-2431
14	seal (spare for 149)	67-5697
15	quick connect plug	103-5400**
16	injector support assy (92 marine)	77-0913**
17	push rod extension (92 marine)	77-0912**
18	fuel connector (92 marine)	77-0866**

* (based on drawing 67-7632S1R5)

** (not shown)



A1.0 APPENDIX A: CALIBRATOR AUDIT KIT

A1.1 DESCRIPTION

The Calibrator Audit Kit is required for checking the critical parameters of the CD3 Calibrator in the field. This allows the user to periodically insure his unit is set to original factory specifications. This kit is calibrated at the factory using instrumentation whose accuracy is traceable to NIST (National Institute of Science and Technology). Bacharach offers recalibration service.

A detailed set of instructions is included which shows the step by step audit procedure. All components are housed in a convenient carrying case.

A1.2 KIT COMPONENTS

Dead Weight Tester - Used to measure and adjust injector inlet pressure.

Test Gage Set - Consisting of a precision 0 - 600 psi gage and shutoff valve, it is used to check gear pump pressure and test discharge head performance.

Viscor Cup - Used to check the viscosity of the calibration fluid. Each cup is serialized and calibrated by the calibration fluid manufacturer.

Dummy Injector Assembly - Simulates the injector for setting the exact inlet pressure using the dead weight tester. It is also used to check the discharge head performance.

Digital Indicator - Indicates the clamping force in lbs. or temperature in °F, depending on the component connected, temperature transducer or load cell.

Temperature Transducer Assembly - Consists of an electronic sensor built into a fitting to provide accurate fuel temperature measurement near the injector inlet.

Load Cell Assembly - Consists of a load sensing device with an electrical output. Includes adapters that enable measurement of body to seat and plunger to body clamping forces.

A1.3 ORDERING INFORMATION

Part No.	Description
67-7707	Calibrator Audit Kit.
77-0452	Gear Pump Relief Valve Kit (Required for Calibrators manufactured before November, 1984).

NOTES: